THE FINNISH ENVIRONMENT 2 | 2019

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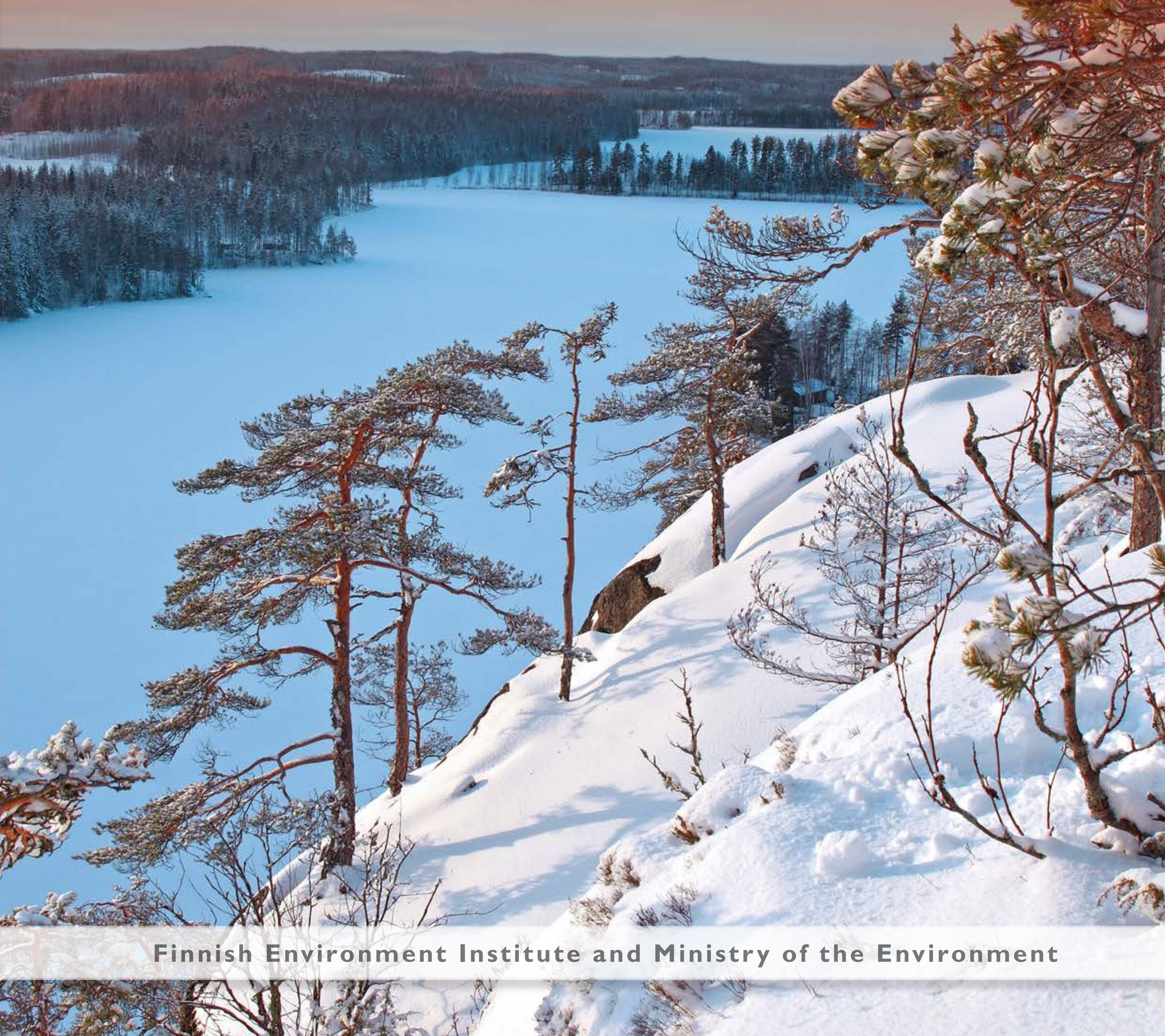
Results and Basis for Assessment

Tytti Kontula and Anne Raunio (eds.)



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Citation:
Kontula, T. & Raunio, A. (eds). 2019. Threatened Habitat Types in Finland 2018. Red List of Habitats – Results and Basis for Assessment. Finnish Environment Institute and Ministry of the Environment, Helsinki. The Finnish Environment 2/2019. 254 p.

Citation for an individual section:
Reinikainen, M., Ryttäri, T., Kanerva, T., Kekäläinen, H., Koskela, K., Kunttu, P., Mussaari, M., Numers, M. von, Rinkineva-Kantola, L., Sievänen, M. & Syrjänen, K. 2018. Baltic Sea coast. In: Kontula, T. & Raunio, A. (eds). Threatened Habitat Types in Finland 2018. Red List of Habitats – Results and Basis for Assessment. Finnish Environment Institute and Ministry of the Environment, Helsinki. The Finnish Environment 2/2019. pp. 61–71

Finnish Environment Institute and Ministry of the Environment

ISBN 978-952-11-5110-1 (PDF)
ISSN 1796-1637 (online)

Cover photo: Juha Jantunen
Graphic design: Satu Turtiainen, Finnish Environment Institute
Layout: Faktor Oy
Translations: Käännös-Aazet Oy / Anu Pöllänen and Michele Alppi

Helsinki 2019

PEFC/02-31-128

4041 0955

FOREWORD

The climate, natural environment and society around us are changing at an accelerating pace. Under the UN Convention on Biological Diversity (CBD), the EU biodiversity strategy and Finland's Biodiversity Action Plan, we have made a commitment to halting biodiversity loss by 2020. Assessments of the threat status of species and habitat types are the most important indicators used to monitor the state of biodiversity, and their results are continuously alarming.

The second assessment of the threat status of Finnish habitat types is a very extensive examination of 388 habitat types and several habitat type groups conducted on the basis of voluminous data by more than 120 experts in eight expert groups. The work was coordinated by the Finnish Environment Institute and participated in by all key national actors, such as Metsähallitus Parks & Wildlife Finland, the Natural Resources Institute Finland, the Geological Survey of Finland, several universities, the Finnish Museum of Natural History, the Centres for Economic Development, Transport and the Environment, the Government of Åland, the Finnish Forest Centre and the Reindeer Herders' Association. The work was steered and co-funded by the Ministry of the Environment, and there was a steering group appointed by the Ministry which included the key organisations producing habitat type data.

Compared with the first national assessment of threatened habitat types completed in 2008, the knowledge base concerning habitat types has increased considerably, especially regarding Baltic Sea underwater habitats, inland waters and their shores as well as mires. The classification of habitat types has otherwise undergone moderate amendments, but it is now substantially more specific with regard to the classification of Baltic Sea habitat types and, on the other hand, more combinatory in the classification of forests. The biggest changes have, however, taken place in assessment methodology. The national method used previously has been replaced by the peer-reviewed Red List of Ecosystems (RLE) methodology developed through broad international cooperation by the International Union for Conservation of Nature (IUCN). Assessment work using the new method is quite labour-intensive and requires both calculations based on data and interpretations by experts. Following the various changes, the assessment is now more comprehensive, quantitative, reliable, transparent and internationally comparable. Comparisons with the previous national results are, however, rather difficult and require, at a minimum, the identification of changes arising from differences in methodology.

In-depth assessments employing consistent methods conducted by Finland's best experts in the state of the habitat types, as well as proposals for action to improve the state of habitat types, are highly important and welcome so that we can identify and target Finland's key protection needs for the future. The data was utilised immediately in Finland's Habitats Directive reporting in spring 2019 and will be employed when updating national action plans for enhancing biodiversity. Among the threats faced by habitat types, climate change has become more and more significant, especially in the contexts of fell habitat types and water bodies. This calls for novel, more efficient actions to safeguard habitat types.

All in all, the threat status assessment of habitat types is an excellent demonstration of the competencies, commitment and cooperation of Finnish experts as well as of the new innovations and applications brought about by the shared use of data. In the future the results will serve various administrative branches and research thanks to, for example, new geospatial datasets. Being a forerunner in the large-scale introduction of the new RLE methodology of the IUCN also provides Finland with opportunities for international influence in the development of the method as well as in global nature conservation solutions of the future. The Ministry of the Environment is grateful for the work that has been done and supports the continuation of the habitat types cooperation network. As a further step, the Ministry has launched preparations on the basis of the assessment results for increasing the efficiency of measures to safeguard habitat types and to improve the state of declined habitat types.

Aulikki Alanen

Senior Ministerial Adviser, Ministry of the Environment

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Introduction 1

1.1
Project background

The first assessment of threatened habitat types in Finland was conducted by a broad group of experts from 2005 to 2007 and published in 2008. The aim was to create an overall picture of the state of habitat types in the country and to raise habitat types alongside species as indicators of biodiversity. Awareness of habitat types has indeed increased since the first assessment. The concept of 'threatened habitat types' has become established in documents such as the environmental administration's programmes and plans and in part also in nature surveys and impact assessments relating to land use planning. Threatened habitat types do not, however, have an official status under, for example, Finnish nature conservation legislation.

The second assessment of the threat status of habitat types is published ten years after the first one. The knowledge base has in the meantime improved for a few habitat type groups, but at the same time the need for data on the state of habitat types and related development has increased even further. A comprehensive view of the state of biodiversity is needed against the background that, by 2020, biodiversity loss should be halted in accordance with the commitments made under the UN Convention on Biological Diversity (CBD), the EU biodiversity strategy and Finland's Biodiversity Action Plan. Because the target set for 2020 cannot be reached, the post-2020 actions required and their most efficient targeting must be planned on the basis of data backed by research. The progression of climate change creates additional challenges for the task.

A nationally developed method was used in the first assessment of Finland's threatened habitat types as there was no international method available. The development of an international one commenced in 2008 at the International Union for Conservation of Nature (IUCN), and in 2014 the IUCN Red List of Ecosystems criteria were adopted for global use. The Finnish Environment Institute took part in the development of the IUCN method and, following trial use, a decision was made to adopt it in Finland.

The IUCN assessment method contains the same main elements as the previous national method, but there are differences in the use of the criteria, which may affect the final outcome of assessments. This makes it difficult to compare the results of the 2008 and 2018 assessments, but this is counterbalanced by the advantages of the new method: the assessment of habitat type quality is more quantitative and therefore more easily repeatable and transparent and the results are internationally comparable. The IUCN method can be expected to become a broadly used standard in the same way as the IUCN assessment methodology for threatened species, so it was found justifiable to adopt it at the earliest possible opportunity.

Seven expert groups were established to conduct the first threat status assessment of habitat types. These groups also operated during the period between the assessments, producing information about topical issues relating to habitat types. For the second assessment, the experts were organised under eight groups as the Baltic Sea and coastal habitat types were divided into separate groups. Some of the experts are the same as in the first assessment, while some are new.

The aim of the project is for the results to provide a knowledge base for actions affecting biodiversity and habitat types both within public administration as well as in the private sector and to facilitate planning and decision-making for ecologically sustainable solutions. The assessment helps the appropriate targeting of restoration, management, protection, research and monitoring. Once the threatened and Near Threatened (NT) habitat types have been identified and described, data on them can be collected more systematically and consistently. This will hopefully improve the quality of nature surveys and facilitate the utilisation of data. The project also identified the most data-deficient habitat types on which inventories and research should be focused.

The assessment of the threat status of habitat types is a research project, with separate decisions to be made on the utilisation of its results and any further measures..

1.2
The work process

Aimed to be as commensurate as possible, the assessment examined the development of the state of Finnish habitat types in compliance with an internationally adopted assessment method. The end product of the work provides a list and descriptions of Finland's threatened, Near Threatened (NT), Least Concern (LC) and Data Deficient (DD) habitat types and presents the grounds for the assessments made. In addition, actions are proposed for the improvement of the state of habitat types that have become threatened.

The project covered all of Finland's habitat types, divided into eight main groups:

- Baltic Sea
- Baltic Sea coast
- inland waters and shores
- mires
- forests
- rock outcrops and scree
- seminatural grasslands and wooded pastures
- fell habitats.

The threat status assessment of habitat types was conducted by expert groups in 2016 and 2017, and its results were compiled for publication in 2018. Before the assessment commenced, the Finnish Environment Institute tested the use of the method on Finnish habitat types and negotiated on its application with experts who took part in the development of the IUCN method. The relevant sections of the guidelines for the application of the IUCN method were translated into Finnish and supplemented by further guidelines required in national work. Finland was among the first countries to adopt the method in a national assessment covering all habitat types.

In early 2016, a steering group was appointed for the project and the commencement of the assessment was announced. In that context, an event was organised to inform stakeholders about the principles applied in the coming assessment. In early 2017, the Ministry of the Environment organised an expert seminar on climate change and on how it will be taken into account in the threat status assessments of habitat types and species.

Where necessary, the expert groups updated and revised the habitat type classification used in the first assessment. The habitat type descriptions were updated and descriptions were produced for the entirely new habitat types. The project also updated the list of Finland's habitat types of national responsibility compiled in conjunction with the 2008 assessment.

During the assessment phase, quantitative, location and qualitative data on habitat types in accordance with the IUCN criteria was collected on the basis of existing literature, geospatial and survey data. The project also produced new data by combining geospatial analyses and datasets. The expert groups conducted the threat status assessments of habitat types on the basis of the data compiled by them and according to the expert input based on the uniform criteria of the assessment method.

The results of the project were presented in a two-part publication in Finnish. This publication in English is a summary of Part 1 of the Finnish final report, which presents the process and results of the threat status assessment and the action proposals drawn up on the basis of the results. Chapter 2 of this publication describes the criteria and application of the IUCN assessment method, including the national supplementary guidelines and examples. Chapter 3 presents the datasets utilised in the assessment. The results of the threat status assessment are presented by habitat group in Chapter 4, and Chapter 5 contains summaries and comparisons covering all of the habitat type groups. Chapter 6 discusses Finland's habitat types of national responsibility and Chapter 7 contains a summary of the actions proposed by the expert groups. These provide suggestions on how to target the protection, management and restoration of habitat types, how threatened habitat types should be taken into account in land use and natural resource utilisation, and on the most important research and monitoring needs relating to habitat types. Chapter 8 gives a summary of the whole publication.

Published only in Finnish, Part 2 of the final report presents all of the 414 assessed habitat types by habitat type group. The description of each habitat type lists the key environmental factors and characteristics of biotic communities, the habitat type's geographical variation, occurrence in Finland, relationship with other habitat types and administrative classifications as well as its IUCN Red List category, the factors affecting its category assignment and the trend for the habitat type's state. The assessment criteria contained in the habitat type descriptions are presented in more detail than in the 2008 assessment in accordance with the IUCN criteria. A photograph and an occurrence map are also given for almost all habitat types.

1.3
Experts and cooperation partners

The threat status assessment of habitat types was coordinated by the Finnish Environment Institute, and the work was co-funded by the Ministry of the Environment. The participating organisations also used their own funding for the work.

The project manager was Anne Raunio, Head of Unit, and the primary researcher and coordinator Tytti Kontula, Senior Research Scientist, from the Finnish Environment Institute.

The project steering group consisted of representatives of public administration and relevant organisations producing habitat type data, comprising the Ministry of the Environment, the Ministry of Agriculture and Forestry, the Natural Resources Institute Finland, the Geological Survey of Finland, the University of Helsinki, Metsähallitus[1] Parks & Wildlife Finland, the Finnish Forest Centre and the Finnish Environment Institute. The steering group was chaired by Senior Ministerial

1 Metsähallitus is a state-owned enterprise that administers state-owned land and water areas.

Adviser Aulikki Alanen from the Ministry of the Environment.

The eight expert groups consisted of more than 120 experts in ecology, hydrobiology, limnology, forest sciences, geology, geography and other disciplines. Their background communities include the Universities of Helsinki, Eastern Finland, Jyväskylä, Turku, Oulu and Lapland, Åbo Akademi University, the Natural Resources Institute Finland, the Geological Survey of Finland, the Finnish Forest Centre, the Ministry of the Environment, the Ministry of Agriculture and Forestry, the Government of Åland, Metsähallitus Parks & Wildlife Finland, the Centres for Economic Development, Transport and the Environment of Southwest Finland, South Savo, North Savo, North Karelia, South Ostrobothnia, North Ostrobothnia and Lapland, the Reindeer Herders' Association, WWF Finland and the Finnish Environment Institute.

As Finland was among the first countries to adopt the IUCN Red List of Ecosystems assessment method and participated in the development of and submitted comments on the method before the assessment, close collaboration also took place with the IUCN. Discussions about the application of the method took place with those including David Keith and Nick Murray (University of New South Wales), Emily Nicholson (Deakin University), Rebecca Miller (IUCN), Lucie Bland (University of Melbourne) and Jon Paul Rodriguez (Venezuelan Institute of Scientific Research). While the Finnish project was underway, threat status assessment of habitat types employing the IUCN method also began in Norway, with Norwegian cooperation partners including Arild Lindgaard and Snorre Henriksen (Norwegian Biodiversity Information Centre) in particular.

ACKNOWLEDGEMENTS

The authors of this publication would like to thank all those that have helped in the assessments by giving their data, sharing their knowledge, commenting on the manuscripts or by other means: Katri Aarnio, Petri Ahlroth, Aulikki Alanen, Ulla Alanen, Heidi Arponen, Antti Below, Christoffer Boström, Ritva Britschgi, City of Rauma, Reino Fagerstén, Camilla Gustafsson, Jari Haapala, Juuso Haapaniemi, Michael Haldin, Pekka Halonen, Carl-Adam Hæggström, Pekka Heikkilä, Raimo Heikkilä, Risto Heikkinen, Teijo Heinänen, Kirsi Hellas, Visa Hietalahti, Sakari Hinneri, Heikki Hirvas, Ari-Pekka Huhta, Jyrki Hämäläinen, Pekka Härmä, Jaana Höglund, Antti Ihalainen, Anna-Riikka Ihantola, Tiina Jalkanen, Juha Jantunen, Hermanni Kaartokallio, Kari Kallio, Minna Kallio, Tapio Kananoja, Linda Kartano, Laura Kauppi, Sanna Kauppinen, Aimo Kejonen, Mari Kekäläinen, Essi Keskinen, Markus Keskitalo, Tuomo Kesäläinen, Marja Koistinen, Tiina Kolari, Johanna Korhonen, Päivi Korhonen, Samuli Korpinen, Meri Koskelainen, Kirsi Kostamo, Harri Kotkanen, Tupuna Kovanen, Sanna-Mari Kunttu, Niina Kurikka, Katriina Könönen, Jussi Laine, Maiju Lanki, Pekka Lehtonen, Niko Leikola, Leif Lindgren, Sampsa Lommi, Janne Lumikanta, Helena Lundén, Tuija Maliniemi, Ilpo Mannerkoski, Petri Metsälä, Markku Mikkola-Roos, Keijo Mild, Sari Mitikka, Catherine and Riggert Munsterhjelm, Ahti Mäkinen, Kalevi Mäkinen, Pekka Niittynen, Annina Niskanen, Marco Nurmi, Henrik Nygård, Lauri Oksanen, Mirjam Orvomaa, Petri Parkko, Ari Parnela, Rauni Partanen, Tanja Peltomäki, Jonna Piiparinen, Sirpa Rasmus, Kajsa Rosqvist, Johanna Ruusunen, Olli Salminen, Tiina Salo, Ellen Schagerström, Anna Schulman, Juha Siitonen, Petri Silvennoinen, Maarit Similä, Jorma Sipilä, Pekka Sipilä, Sari Stark, Esko Tainio, Tiina Tonteri, Tapani Tuovinen, Heikki Törmänen, Jouni Vainio, Anna Villnäs, Päivi Virnes, Elina Virtanen, Tarmo Virtanen, Aarne Wahlgren and Mats Westerbom.

The editors of this publication are very grateful also to Kirsi Hutri-Weintraub, Pälvi Salo, Aija Lehikoinen and Sonja Virta for all their help with the texts and figures of the manuscript and to Anu Pöllänen and Michele Alppi for the English translations of the original texts.

2.1
IUCN Red List of Ecosystems assessment method

The first assessment of threatened habitat types in Finland (Raunio et al. 2008) employed a nationally developed assessment method as no globally applicable assessment methodology for habitat types was even being developed at that point by the International Union for Conservation of Nature (IUCN). For threat status assessments of species, IUCN methodology had already been developed earlier and employed in assessments of threatened species since 2000 (Rassi et al. 2000).

The second assessment of threatened habitat types presented in this publication employed the new IUCN Red List of Ecosystems assessment method intended for habitat types (IUCN 2015). Its basic principles with regard to assessing the quantitative and qualitative development of habitat types are similar to those of Finland's national method, but there are also differences between the methods. Finland was among the first countries in the world to adopt the IUCN method in the assessment of the threat status of habitat types.

Developed in an extensive international cooperation project, the IUCN Red List of Ecosystems Categories and Criteria (Keith et al. 2013) assessment method was adopted by the IUCN Council in 2014, and the official Version 1.0 of the Guidelines was published in 2015 (IUCN 2015). The development of the method is still ongoing, and an updated Version 1.1 of the Guidelines (Bland et al. 2017) was published while the Finnish threat status assessment was underway. The main differences between Versions 1.0 and 1.1 are related to the concept of 'location' and the formulation of expert input. In the Finnish threat status assessment, 'location' has been interpreted in accordance with the newer Version 1.1, that is primarily as a 'threat-defined location', but the guidelines of Version 1.1 for expert elicitation were received too late to affect the assessment.

The new IUCN Red List of Ecosystems (RLE) protocol comprises five criteria for assessing the risk of ecosystem collapse (Figure 2.1). The decline leading to collapse may progress in different ways in habitat types, and the IUCN method groups decline into four main types depicted by criteria A, B, C and D of the method.

Two of the criteria of the IUCN method are to do with the quantity or geographic distribution of the habitat type. Criterion A examines a decline in geographic distribution, which reduces the ability of the habitat type to sustain its characteristic native biota. Criterion B is to do with restricted geographic distribution, which subjects habitat type occurrences to spatially explicit threats.

Two of the criteria in turn examine functional changes in habitat type occurrences. Criterion C assesses abiotic (environmental) degradation that reduces the capacity of the habitat type to sustain its characteristic biota or causes declines in the diversity of niches available to such species. Criterion D examines disruption of biotic processes or interactions which, for example, lead to

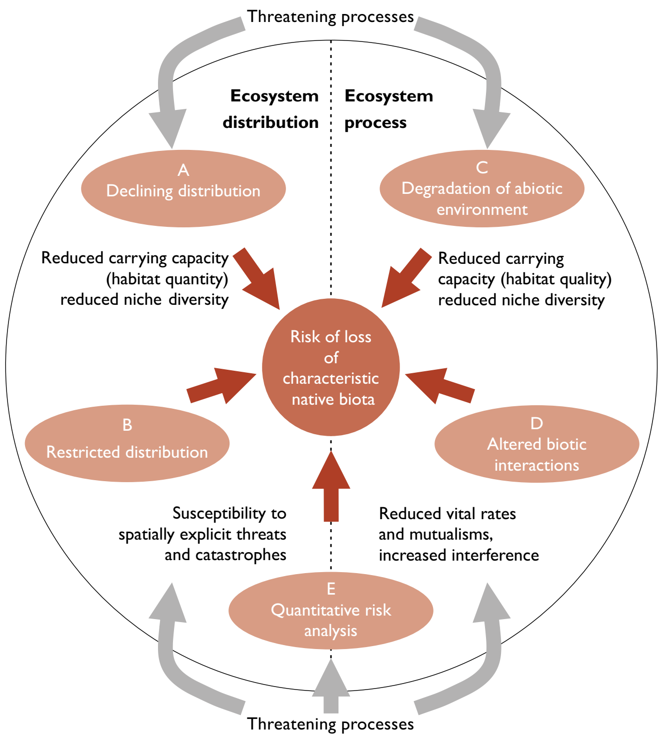

Figure 2.1. Mechanisms of ecosystem collapse and symptoms of collapse risk (source: Keith et al. 2013).

changes in interspecific relationships, reduction in ecological niches or loss of some groups of species.

The fifth criterion (E) is to do with the combined effect of factors leading to the collapse of habitat types. Trends for habitat types are depicted using modelling that produces an estimate of the probability of collapse.

These five criteria form the basis of the IUCN method. A habitat type under assessment should be evaluated using all of the criteria for which data or expert inputs are available. The overall threat status of a habitat type is assigned as the highest category of risk obtained through any criterion.

The method used in this assessment was originally described in the Guidelines for the Application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0 (IUCN 2015). In sections 2.4 and 2.5 of the current publication describing the methodology, the majority of the text consists of direct quotes or summaries of the IUCN Guidelines. In these two sections, the national supplementary parts, such as the supplementary application guidelines and national examples, are provided in maroon text.

2.2 Introduction of the method in Finland and differences from the previous assessment

Following a trial period, a decision was made in 2015 to adopt the IUCN method in the assessment of threatened habitat types in Finland. The IUCN method was regarded as more uniformly repeatable and transparent than the previously used national method, as the assessment of the quality of habitat types is more quantitative in the IUCN method. The international comparability is also an additional advantage.

Although the IUCN method was regarded as rather labour-intensive, its introduction was encouraged by the close cooperation with the IUCN expert group developing the method. Finland took part in the development of the method and commented on and tested earlier versions during the 2010–2015 period. The adoption of the IUCN method was also supported by that fact that one of the objectives set by the Action Plan for Improving the State of Threatened Habitat Types in Finland (Ministry of the Environment 2011) was for the coming IUCN assessment method to be established globally and also used in Finland.

The nationally developed method employed in Finland's first threat status assessment of habitat types consisted of two main criteria: change in habitat type quantity and change in habitat quality (Raunio et al. 2008; Kontula and Raunio 2009). The national assessment method and the IUCN method are largely based on the same notions of the relationship between changes taking place in a habitat type and its threat status, but there are several differences between the structure and details of the sets of criteria.

The national method involved steps and always used changes in habitat type quantity and quality over the past 50 years as the starting point for the assessment. This preliminary assessment obtained from the first assessment step was specified further on the basis of projections of future development, early decline or deterioration, and rarity or commonness. With the exception of the option of assigning a lower category on the basis of commonness, these same assessment factors are found in the IUCN method – but as independent criteria or subcriteria.

In the IUCN method, only some of the criteria (A1, C1 and D1) are based on changes in the past 50 years. Future changes are assessed under criteria A2, C2 and D2 and early-onset changes over the historical time frame under criteria A3, C3 and D3. The IUCN method has a specific criterion (B) for rare, declined habitat types. The final outcome of the assessment is determined in the IUCN method by the criterion on the basis of which the risk of collapse is assessed as the highest.

There are also other differences between the old and the new assessment method. In the first threat status assessment, the lower limit for the assignment of the Vulnerable (VU) category under the quantitative criterion A was a decrease of at least 20%, whereas in the IUCN method the corresponding threshold is 30%. The lower 20% limit was in line with the earlier criteria for species threat status assessments where the lower limit for population size reduction had been 20% for VU. The 30% threshold was subsequently introduced in the species assessment criteria and also agreed for application in the quantity criterion of the threat status assessments of habitat types.

The Red List categories of both methods are based on the corresponding Red List categories of species. In the national method, the category of 'Regionally Extinct (RE)' was used for lost habitat types. In the new IUCN method this has been replaced by 'Collapsed (CO)'.

2.3 Categories of the IUCN Red List of Ecosystems

The IUCN Red List of Ecosystems includes eight categories: Collapsed (CO), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE) (Figure 2.2).

The first six categories (CO, CR, EN, VU, NT and LC) are ordered in decreasing risk of collapse. The categories Critically Endangered, Endangered and Vulnerable indicate threatened ecosystems. The categories Data Deficient and Not Evaluated do not indicate a level of risk. Following the precautionary principle, the overall status of an ecosystem type is the highest risk category obtained through any criterion.

Collapsed (CO). An ecosystem is Collapsed when it is virtually certain that its defining biotic or abiotic features are lost from all occurrences, and the characteristic native biota are no longer sustained. Collapse may occur when most of the diagnostic components of the characteristic native biota are lost from the system, or when functional components (biota that perform key roles in ecosystem organisation) are greatly reduced in abundance and lose the ability to recruit.

Critically Endangered (CR). An ecosystem is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered. It is therefore considered to be at an extremely high risk of collapse.

Endangered (EN). An ecosystem is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered. It is therefore considered to be at a very high risk of collapse.

Vulnerable (VU). An ecosystem is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable. It is therefore considered to be at a high risk of collapse.

Near Threatened (NT). An ecosystem is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC). An ecosystem is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widely distributed and relatively undegraded ecosystems are included in this category.

Data Deficient (DD). An ecosystem is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of collapse based on decline in distribution, disruption of ecological function or degradation of the physical environment. Data Deficient is not a category of threat, and does not imply any level of collapse risk. Listing of ecosystems in this category indicates that their situation has been reviewed, but that more information is required to determine their risk status.

Not Evaluated (NE). An ecosystem is Not Evaluated when it is has not yet been evaluated against the criteria.

2.4
Key principles of the assessment method

The majority of the texts in this chapter are based directly on the Guidelines for the Application of IUCN Red List of Ecosystems Categories and Criteria (IUCN 2015). The texts in maroon contain the national supplementary parts, such as the supplementary application guidelines or national examples.

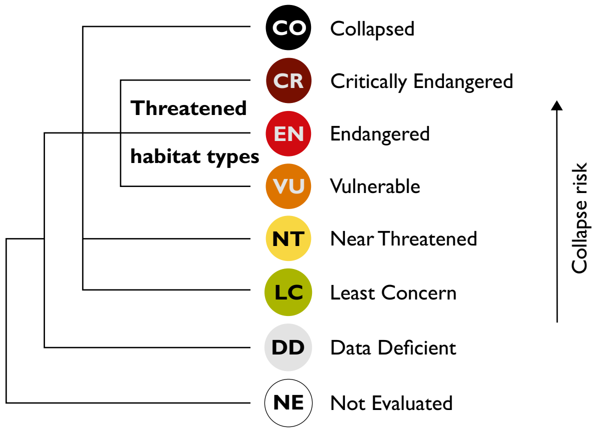

Figure 2.2. Structure of the IUCN Red List of Ecosystems categories (IUCN 2015).

2.4.1
Time frames

The criteria assess declines over four specified time frames: the recent past, the present, the future, and the historical past (Figure 2.3).

The 'recent past' time frame encompasses the past 50 years, which is sufficiently recent to capture current trends but long enough to distinguish directional change from natural variability. The RLE protocol assumes that declines over this time frame are indicative of future risk irrespective of cause. Decline due to natural causes also affects the risk level assessment.

Assessment of future declines requires predictions of changes over the next 50 years or any 50-year period including the present and future. Past declines may provide a basis for such predictions, but other information may support predictions and inferences about rates of future decline even when the ecosystem is currently stable. Such predictions require a defensible assumption about the pattern of future change (e.g. accelerating, constant, decelerating).

Assessments of historical declines are essential for ecosystems containing biota with long generation lengths and slow population turnover (Mace et al. 2008). They are also essential for foundation species with short generation lengths which may have suffered extensive historical declines. Even where future rates of decline abate, historical reductions in distribution or function may predispose an ecosystem to additional threats and reduce its ability to absorb adverse changes (Folke et al. 2004).

Historical declines are assessed relative to ecosystem status at a notional reference date of 1750, corresponding approximately to the earliest onset of industrial-scale exploitation of ecosystems. In parts of the world where industrial-scale exploitation of ecosystems commenced earlier or later than 1750, it is justifiable to assess historical declines with a different baseline. Distribution models with environmental predictors may be used to estimate historical declines based on the difference between the current state of an ecosystem

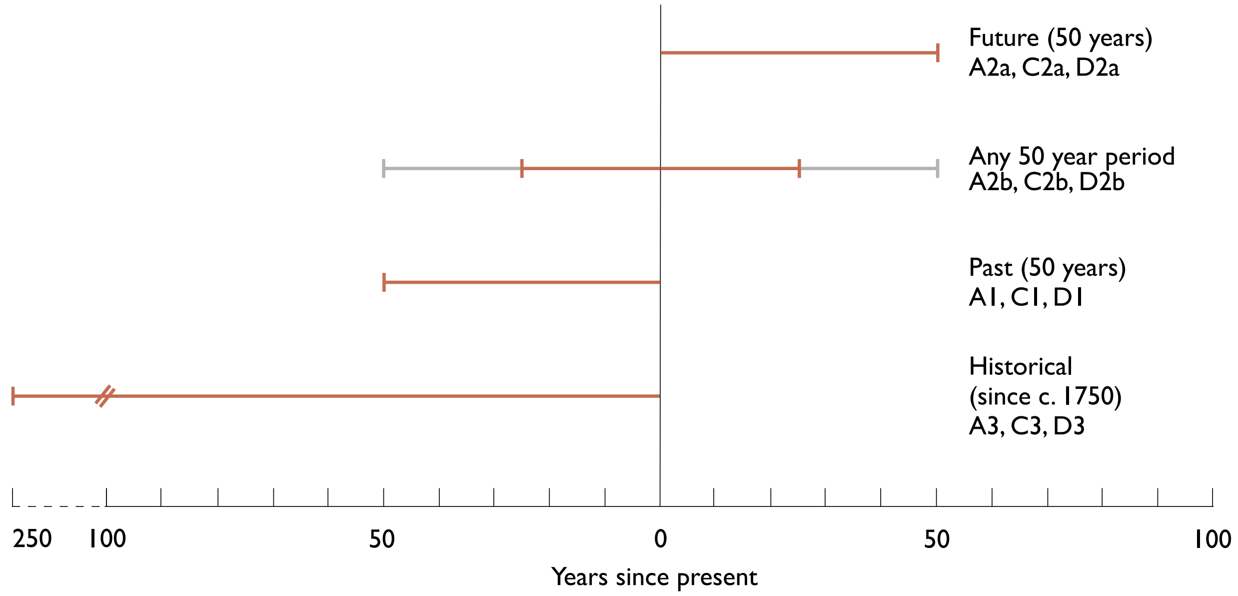

Figure 2.3. Time frames for assessment of change under criteria A, C, and D (adapted from Keith et al. 2013).

and its expected state in the absence of industrial-scale anthropogenic effects. Such approaches are most useful in regions where landscape-scale change did not occur before the industrial era.

2.4.2 Defining ecosystem collapse

The threat status assessment evaluates the risk of ecosystem collapse. Collapse is the end point of a negative trend for a habitat type which may be the outcome of multiple different declines. Using the IUCN criteria requires capacity to analyse the speed and intensity of changes having taken place in a habitat type and the reasons for its decline.

According to the IUCN Red List of Ecosystems Categories and Criteria, "an ecosystem is Collapsed when it is virtually certain that its defining biotic or abiotic features are lost from all occurrences, and the characteristic native biota are no longer sustained. Collapse may occur when most of the diagnostic components of the characteristic native biota are lost from the system, or when functional components (biota that perform key roles in ecosystem organisation) are greatly reduced in abundance and lose the ability to recruit."

Unlike species, ecosystems do not disappear; rather they transform into novel ecosystems with different characteristic biota and mechanisms of organisation (Hobbs et al. 2006; Keith et al. 2013; Keith et al. 2015). Many characteristic features may disappear long before the last characteristic species disappears from the last ecosystem occurrence (assemblage extinction; Gaston and Fuller 2008). The novel systems may retain some of the characteristic biota of the collapsed systems that they replace, but the abundance of those species, their interactions or ecological functions are altered.

Ecosystem collapse may in theory be reversible – given a long time frame, or via the reintroduction of characteristic biota and/or the restoration of ecosystem function – but in many systems recovery will not be possible.

There are major differences between the risks of collapse of habitat types. Those facing a high risk include seminatural grasslands and wooded pastures, which begin to decline and inevitably disappear without the right type of management. At the other end of the spectrum there are habitat types such as frost-weathered boulder fields of the fell area and many rock outcrop habitat types. They may decline due to various factors, but their collapse over a period of 50 years is highly unlikely.

The collapse of a habitat type due to changes in land use is an easy-to-understand and unambiguous event. These changes affecting the area or number of occurrences are examined under IUCN criteria A and B. They may be caused by activities such as construction, ditch drainage or afforestation of an open habitat type.

A habitat type may also end up classified as Collapsed (CO) under criteria C and D where, instead of a quantitative reduction, the focus is on a decline in quality. Further and further decline in quality eventually results in a state where the occurrences of the habitat type no longer sustain its characteristic native biota. This is when the habitat type is regarded as CO on the basis of criterion C or D.

The qualitative decline of a habitat type may involve a clear threshold the passing of which results in the classification of the habitat type as Collapsed (CO). Collapse is particularly appropriate to describe events where the occurrences of a habitat type disappear rapidly and unavoidably after the passing of the threshold.

2.4.3
Use of criteria and assignment of overall Red List category

Each ecosystem type must be assessed against all of the RLE criteria so far as the available data permits. At the onset of an assessment, all ecosystem types are considered Not Evaluated (NE) for all criteria. The next step is to determine whether adequate data exists for application of the criteria, which requires data searches of the scientific literature, unpublished reports, expert opinion, historical accounts, past and present maps, satellite imagery or any other source of relevant data.

A habitat type may be considered Not Evaluated (NE) under a specific criterion in cases including where there is no suitable variable (or, with regard to criterion E, a suitable model) for the application of the criterion or no such variable can be developed. If a reasonable search effort indicates that adequate data is not available to assess under a criterion, the risk assessment outcome for this criterion is Data Deficient (DD).

Following the precautionary principle and to ensure that the most severe symptoms of risk determine the assessment outcome, the highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem. The main method currently used for representing uncertainty in ecosystem assessment is to use bounded estimates. However, the most plausible threat category is given also in this case.

The lower bound of the overall status is the highest lower bound across any of the subcriteria that return the same category as the overall status. The upper bound of the overall status is the highest upper bound across any of the subcriteria that return the same category as the overall status. For example, if the highest threat category for a habitat type is Endangered both under criteria A1 and C1, and the bounded estimates for A1 is NT–EN and for C1 is VU–CR, the overall risk status for this habitat type will be Endangered and the bounded estimate VU–CR.

If all subcriteria are Data Deficient, the overall outcome of the assessment is Data Deficient. If all subcriteria are Not Evaluated, the overall outcome of the assessment is Not Evaluated. If all subcriteria are either Not Evaluated or Data Deficient, the overall outcome of the assessment is Data Deficient.

In cases where different criteria produce Least Concern (LC) and Data Deficient (DD) but no other categories as the outcome, the final Red List category may be assigned on the basis of expert input. In such cases, the assignment of LC indicates that the state of the habitat type is regarded as fairly good, even though the Red List category could not be determined under all of the criteria due to deficiency of data. DD in turn is a justified category assignment is cases where the decline of a poorly known habitat type is suspected but one or more criteria point towards classifying it as LC.

2.5
Criteria and thresholds

The majority of the texts in this chapter are based on the Guidelines for the Application of the IUCN Red List of Ecosystems Categories and Criteria (IUCN 2015). The text in maroon contains the national supplementary parts, such as the supplementary application guidelines or national examples.

The IUCN Red List of Ecosystems (RLE) risk assessment model includes five criteria for assessing the risk of ecosystem collapse (Table 2.1). This section describes the scientific background to and thresholds of each criterion as well as the subcriteria. A table summarising the Red List categories and criteria can be found in Appendix 1.

2.5.1
Criterion A. Reduction in geographic distribution

2.5.1.1
Theory

A decline in geographic distribution – defined as all spatial occurrences of an ecosystem type – influences its risk of collapse by: (i) reducing the ability of an ecosystem to sustain its characteristic native biota; and (ii) predisposing it to additional threats (Keith et al. 2013). The loss of characteristic native biota due to a declining distribution typically occurs through a combination of reduced carrying capacity, niche diversity, spatial partitioning of resources, and increased susceptibility

Table 2.1. Purpose of the IUCN Red List of Ecosystems criteria (IUCN 2015).

	Criterion	Purpose
A	Reduction in geographic distribution	Identifies ecosystems that are undergoing declines in area, most commonly due to threats resulting in ecosystem loss and fragmentation.
B	Restricted geographic distribution	Identifies ecosystems with small distributions that are susceptible to spatially explicit threats and catastrophes.
C	Environmental degradation	Identifies ecosystems that are undergoing environmental degradation.
D	Disruption of biotic processes or interactions	Identifies ecosystems that are undergoing loss or disruption of key biotic processes or interactions.
E	Quantitative analysis that estimates the probability of ecosystem collapse	Allows for an integrated evaluation of multiple threats, symptoms, and their interactions.

Table 2.2. Subcriteria, time frames and thresholds in criterion A (IUCN 2015).

Subcriterion	Time frame	CR	EN	VU
A1	Past (over the past 50 years)	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years)	≥ 80%	≥ 50%	≥ 30%
A2b	Any 50-year period (including the past, present and future)	≥ 80%	≥ 50%	≥ 30%
A3	Historical (since approximately 1750)	≥ 90%	≥ 70%	≥ 50%

to competition, predation and threats (MacArthur and Wilson 1967; Shi et al. 2010; Harpole and Tilman 2007; Hanski 1998; McKnight et al. 2007). The rate of decline in an ecosystem distribution indicates its trajectory towards collapse, with ecosystem collapse typically occurring when no spatial occurrences of the ecosystem type remain (extent of distribution collapses to zero).

2.5.1.2
Thresholds and subcriteria

An ecosystem may be listed under criterion A if it meets the thresholds for any of four subcriteria (A1, A2a, A2b or A3), quantified as a reduction in geographic distribution over the time frames given in Table 2.2.

2.5.1.3
Application

To apply criterion A, comparable estimates of the distribution of the habitat type at different points in time are required. Quantity can be measured in different ways for different habitat types using, for example, the total combined area of habitat type occurrences, the number of grid cells with occurrences, the number of occurrences or, for linearly occurring habitat types, the total combined length of occurrences.

At its simplest, a threat status assessment under criterion A requires an estimate of the habitat type's distribution 50 years ago or around 1750 as well as in the present day. In such cases, subcriterion A1 or A3 can be applied directly without assumptions about rate of change, for example.

Data is not, however, always available for these specific points in time. For example, it may be necessary to compare the current distribution of a habitat type with quantitative estimates dating back more than 50 years and to interpolate the estimate for 50 years ago between those values. Examinations of future time frames (subcriteria A2a and A2b) in turn extrapolate estimates of future distributions on the basis of changes having taken place in the past.

When using both interpolation and extrapolation, the likely trajectory must be inferred on the basis of information such as the causes of the decline. The more data points there are in the time series concerning change in the habitat type's distribution, the more reliably the quantitative trend can be inferred and the more accurate the assessments obtained through interpolation and extrapolation. Especially in cases where there is uncertainty concerning the quantitative trajectory, it is recommended that at least two plausible alternative scenarios be explored.

2.5.2
Criterion B. Restricted geographic distribution

2.5.2.1
Theory

The size of the geographic distribution of an ecosystem influences its risk of collapse when confronted with a spatially explicit threat or catastrophe (Keith et al. 2013). In general, ecosystems that are widely distributed or exist across multiple independent patches are at lower risk from catastrophes, disturbance events or any other threats that exhibit a degree of spatial contagion (e.g. invasions, pollution, fire, forestry operations, and hydrological or regional climate change).

The primary role of criterion B is to identify ecosystems whose distribution is so restricted that they are at risk of collapse from the chance occurrence of single or few interacting threatening events (Rodríguez et al. 2015).

Even if rare, a habitat type is not classified as threatened under criterion B unless confronted with a threat whose significance is at least rather high.

2.5.2.2
Thresholds and subcriteria

An ecosystem may be listed under criterion B if it meets the thresholds for either of three subcriteria (B1, B2 and B3), which indicate restricted geographic distribution (Table 2.3).

2.5.2.3
Application

In the threat status assessment of Finland's habitat types, criterion B is not applied separately in the subregions of Southern and Northern Finland in cases where the uniform geographic distribution of a habitat type focusing on the north or the south would be artificially split into two parts due to the regional division.

The geographic distribution of an ecosystem type is assessed under criterion B with two standardised metrics: the extent of occurrence (EOO) and the area of occupancy (AOO) (Gaston and Fuller 2009; Keith et al. 2013). In addition, assessment of criterion B requires a qualitative evaluation of whether continuing declines in spatial extent, environmental quality, or increasing disruption of biotic interactions are occurring or likely to occur as a result of threats. Lastly, it requires an estimate of the number of locations at which an ecosystem occurs.

Table 2.3. Subcriteria and thresholds in criterion B (IUCN 2015).

B1. Extent of a minimum convex polygon (km²) enclosing all occurrences (extent of occurrence, EOO) is:			
CR	2 000 km²	AND at least one of the following (a–c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exists at: 1 location
EN	20 000 km²	AND at least one of the following (a–c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exists at: 5 locations
VU	50 000 km²	AND at least one of the following (a–c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exists at: 10 locations

B2. The number of 10×10 km grid cells occupied (area of occupancy, AOO) are:			
CR	2	AND at least one of the following (a–c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exists at: 1 location
EN	20	AND at least one of the following (a–c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exists at: 5 locations
VU	50	AND at least one of the following (a–c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exists at: 10 locations

B3. A very small number of locations:	
VU	A very small number of locations (generally fewer than 5) AND prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of Collapse or becoming Critically Endangered (CR) within a very short time period (B3 can only lead to a listing as Vulnerable, VU).

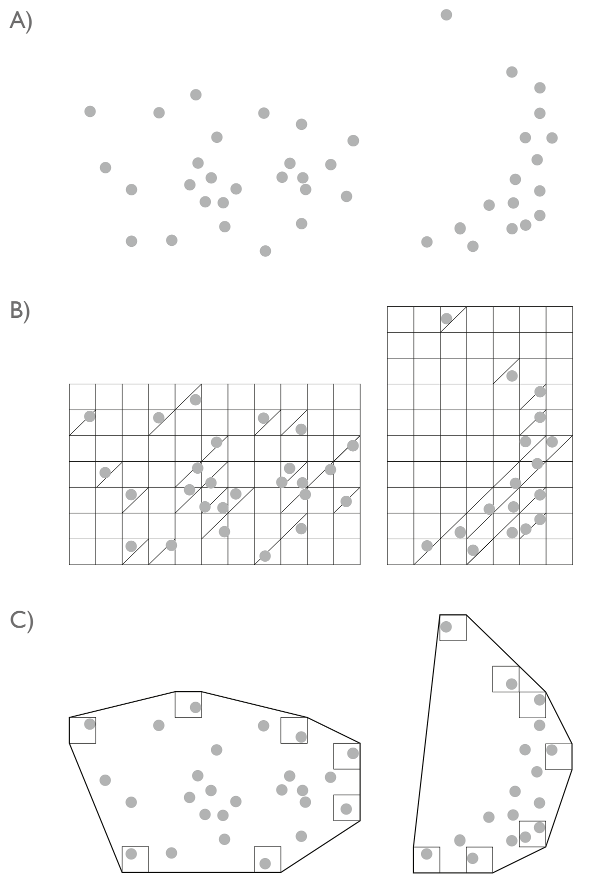

Figure 2.4. Size of geographic distribution in the application of criterion B. A) Two different habitat type occurrence groups. B) Estimating area of occupancy (AOO) by counting the 10 x 10 km² grid cells. C) Estimating extent of occurrence (EOO) on the basis of grid cells using the minimum convex polygon method.

Assessing spatial metrics for criteria B1 and B2

The two standardised measures of ecosystem distribution represent conceptually different aspects of geographic range size (Rodríguez et al. 2015; Keith et al. 2013). The EOO (subcriterion B1) measures the spread of risk over a contiguous area that encloses all occurrences using a minimum convex polygon. In contrast, the AOO (subcriterion B2) measures the spread of risk among occupied patches through a count of occupied grid cells (Keith et al. 2013). Ensuring standardised application of these methods is critical for objective measurement of the size of a spatial distribution.

Extent of occurrence (EOO). The EOO of an ecosystem is measured by determining the area (km²) of a minimum convex polygon – the smallest polygon that encompasses all known occurrences of a focal ecosystem in which no internal angle exceeds 180 degrees – fitted to an ecosystem distribution. The minimum convex polygon (also known as a convex hull) must not exclude any areas, discontinuities or disjunctions, regardless of whether the ecosystem can occur in those areas or not. Regions such as oceans (for terrestrial ecosystems), land (for coastal or marine ecosystems) or areas outside the study area (such as in a different country) must remain included within the minimum convex polygon to ensure that this standardised method is comparable across ecosystem types. In addition, these features contribute to spreading risks across the distribution of the ecosystem by making different parts of its distribution more spatially independent.

It has been agreed nationally that the extents of occurrence are determined along the boundaries of 10 x 10 km² grid cells occupied by habitat type occurrences, which means a distribution has a specific minimum width even if there are only two occurrences.

Using global absolute thresholds in the examination of geographic distributions may be problematic in national or regional assessments when the area examined is very small. However, according to the developers of the IUCN method, an area the size of Finland or the subregions of Southern and Northern Finland used in the assessment are not to be regarded as so small as to prevent applying criterion B to them.

Area of occupancy (AOO). The AOO of an ecosystem defined in the RLE is determined by counting the number of 10 × 10 km² grid cells that contain the ecosystem (Figure 2.4). This relatively large grain size is applied for three reasons:

(i) ecosystem boundaries are inherently vague (Regan et al. 2002), so it is easier to determine that an ecosystem occurrence falls within a larger grid cell than a smaller one;
(ii) larger cells may be required to diagnose the presence of ecosystems characterised by processes that operate over large spatial scales
(iii) larger cells allow AOO estimation even when high resolution distribution data is limited.

Finnish estimates of AOO employ the same 10 x 10 km² grid as used in habitat type reporting under the Habitats Directive (EEA reference grid 2018).

Assessing subcriteria B1 and B2

To be eligible for listing under subcriteria B1 or B2, an ecosystem must meet the EOO or AOO thresholds that delineate threat categories, as well as at least one of three subcriteria that address various forms of decline. These subcriteria distinguish restricted ecosystems at appreciable risk of collapse from those that persist over long time scales within small stable ranges (Keith et al. 2013). Only qualitative evidence of continuing decline is required to invoke the subcriteria, but relatively high standards of evidence should be applied.

Subcriteria B1a and B2a address continuing declines in ecosystem distribution, abiotic environment or biotic processes. To invoke this subcriterion, the declines must:

(i) reduce the ability of an ecosystem to sustain its characteristic native biota;
(ii) be non-trivial in magnitude; and

(iii) be more likely than not to continue into the future.

Also regarded as continuing decline is a situation where a key quality factor of a habitat type is continuously in a poor state even though no longer declining further.

Episodic or intermittent declines qualify as continuing, so long as they are recurring and uncompensated by increases of comparable magnitude. Downward phases of cyclical changes or fluctuations do not qualify as continuing declines. These requirements imply an understanding of the causes of decline to support a correct inference.

Subcriteria B1b and B2b do not require evidence of past or current declines, but may be invoked by future declines inferred from serious and imminent threats. For these subcriteria, assessors must:

(i) identify one or more specific threatening processes;
(ii) present convincing and generally agreed evidence that such threats are very likely to cause continuing declines within the next two decades.

These requirements imply an understanding of how the threats affect the defining features of the ecosystem and the timing of their effects. Speculation about generic threats with uncertain impacts or onset is discouraged. Relevant evidence includes observations of similar threats in the past or on similar ecosystems, as well as accumulated knowledge about the behaviour and nature of the threat itself. The significance of threats under B1b or B2b must be at least rather high.

Subcriteria B1c and B2c require an estimate of the number of locations that are occupied relative to the extent of serious plausible threats. A location is defined as a geographically or ecologically distinct area in which a single threatening process can rapidly affect all occurrences of an ecosystem type. The size of the location depends on the area covered by the threatening process and may include part of one or many separate patches of the ecosystem. Where an ecosystem type is affected by more than one threatening event, locations should be defined by considering the most serious plausible threat.

A river with its shore habitat types can be examined as an example of the determination of a threat-defined location. An individual discharge of a harmful substance may have an adverse effect on all of the occurrences of a shore habitat type downstream by the same river but not on occurrences by different water bodies, even if located close to each other. In such a case, all of the occurrences by the same river are regarded as a single threat-defined location. When applying subcriteria B1c and B2c, the significance of the plausible threat must be at least rather high and the threat must potentially materialise within approximately 20 years. If there are no threats that are at least rather high for the occurrences of the habitat type, the result under subcriteria B1c and B2c is Least Concern (LC).

Assessing subcriterion B3

Subcriterion B3 comprises two parts which must both be met for an ecosystem type to qualify for Vulnerable status. First, the ecosystem type must have a very restricted distribution, generally with fewer than five locations. Second, the ecosystem type must be facing severe threats (human activities or stochastic events) within a very short time period in an uncertain future, and thus capable of collapse or becoming Critically Endangered within a very short time period.

The short time frame used under subcriterion B3 is the next 20 years.

2.5.3 Criterion C. Environmental degradation

2.5.3.1 Theory

The RLE risk model defines two criteria for assessing declines in ecosystem functions or processes. Two criteria are needed to assess abiotic (environmental) and biotic degradation because the causes, effects and mechanisms of functional decline differ fundamentally between them (Keith et al. 2013).

Abiotic degradation is the deterioration of the physical, non-living attributes that have a defining role in ecological processes and/or the distribution of an ecosystem type. Abiotic degradation reduces the capacity of an ecosystem to sustain its characteristic biota. For example, declines in limiting resources (niche dimension) reduce species diversity in a range of terrestrial, freshwater and marine ecosystems (Harpole and Tilman 2007).

The strict application of the IUCN Guidelines involves the use of a single variable or, alternatively, multiple variables used independently, to measure the abiotic degradation of habitat types. There are, however, cases where there is no such measurable quality variable available that would sufficiently explain a comprehensive qualitative change. In such cases, quality assessment methods other than those primarily recommended by the IUCN Guidelines need to be employed. For example, a more comprehensive view of the qualitative change needs to be obtained based on expert inputs or multiple quality variables. If the quality variables examined together represent both abiotic and biotic changes, the assessment is – by way of deviation from the IUCN Guidelines – recorded under the combined criterion CD. Alternative quality assessment methods are described in section 2.5.3.4 and national examples of the use of criteria C, D and CD are provided in section 2.5.5.

Table 2.4. Subcriteria, time frames and thresholds in criterion C (IUCN 2015).

		Relative severity (%)		
	Extent (%)	≥ 80	≥ 50	≥ 30
C1. The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		
	Extent (%)	≥ 80	≥ 50	≥ 30
C2a. The next 50 years, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; OR **C2b.** Any 50-year period including the past, present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		
	Extent (%)	≥ 90	≥ 70	≥ 50
C3. Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
	≥ 70	EN	VU	
	≥ 50	VU		

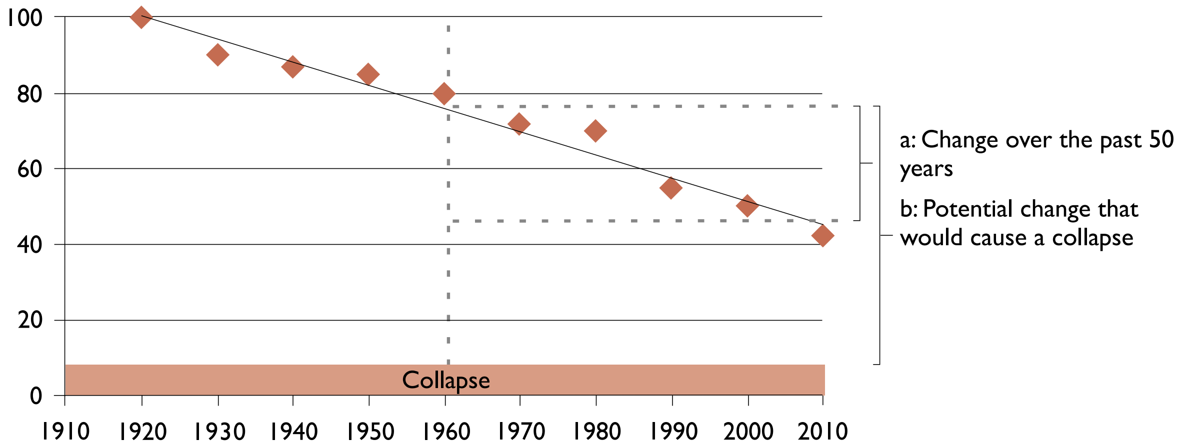

Figure 2.5. Evaluation of the relative severity of degradation under criteria C and D when a measurable variable suitable for assessing change in overall quality is available. Here the value of the variable is within the 0–100 range. In the graph, 'a' indicates change in the 1960–2010 period and 'b' the potential maximum change from 1960 until the presumed collapse already caused by the fall of the variable under 10. Relative severity = a/b.

2.5.3.2

Thresholds and subcriteria

An ecosystem may be listed under criterion C if it meets the thresholds for any of four subcriteria (C1, C2a, C2b, or C3), which express different levels of environmental degradation over the time frames given in Table 2.4.

2.5.3.3

Application

Selection of variables

To apply criterion C, data or estimates of the severity and extent of abiotic degradation are required. As quality assessment under criteria C and D is time-consuming, it has been decided in order to increase the efficiency of assessment work that, in clear cases where there are no observations or inferred suspicions of significant negative changes or threats, these criteria can be assessed directly as Least Concern (LC).

If observations or suspicions of degradation exist, assessing abiotic degradation requires suitable scalar variables for estimating the severity of degradation, as well as suitable spatial variables for estimating the extent of degradation. The characteristics of the ecosystem and its threats will determine which variables are relevant. Variables with direct and clear cause-effect relationships and the greatest sensitivity to loss of characteristic native biota will be the most suitable.

There must be plausible evidence of a causal relationship between the process of environmental degradation and the loss of characteristic native biota. For example, an assessment of wetland degradation based on change in water quality would require evidence that declines in water quality are associated with loss of wetland biota, either through direct observation or inference from comparable ecosystem types. A carefully developed conceptual model can highlight key environmental processes and the transitions between healthy and collapsed states to be assessed in criterion C.

According to the IUCN Guidelines, in situations where multiple equally good quantitative variables are available, each variable should be examined independently and the highest Red List category produced by the respective results should be selected. Situations where multiple variables that are equally reliable and indicate overall quality equally well are actually available are rare. It is likely to be more common that there are dissimiliraties between variables data in terms of, for example, coverage or correlation with overall quality. In such cases, the Red List category assigned is the one obtained based on the variable that is the most comprehensive in terms of data or the one that is known to best indicate overall quality.

Concept of relative severity

The key concept for assessing functional declines in either abiotic or biotic variables is relative severity. Relative severity is essential for comparing risks among ecosystems undergoing different types of degradation. An ecosystem is collapsed at the endpoint of ecosystem decline where the characteristic native biota is no longer sustained. A habitat type may be in a collapsed state already before its area is zero.

Relative severity describes the proportional change observed in an environmental variable scaled between two values: one describing the initial state of the system (0%), and one describing a collapsed state (100%). Thus, if an ecosystem type undergoes degradation with a relative severity of 50% over an assessment time frame, this implies that that it has transformed half way to a collapsed state. Figure 2.5 shows how to evaluate the relative severity of degradation.

Information on relative severity is combined with information on the proportion of the ecosystem affected (extent) to determine the risk category under criterion C. Assessors may either estimate the extent of degradation that exceeds a threshold level of severity or estimate the average severity of degradation across the entire ecosystem distribution.

Ecosystems are listed as CR if environmental change is both extremely severe (≥80% relative severity) and extensive (across ≥80% of the distribution) (Table 2.4). Ecosystems may be eligible for listing in lower threat categories if they are undergoing very severe but localised degradation or less severe degradation over extensive areas. Ecosystems that fail to meet the thresholds for the Vulnerable category may be assigned to the Near Threatened category. For example, an ecosystem undergoing >80% decline in environmental quality over 20–30% of its distribution, or >30% decline over 70–80% of its distribution could qualify as Near Threatened. Declines within 5–10% of thresholds for the Vulnerable category may warrant listing as Near Threatened.

In the simplest case, relative severity may be calculated by range-standardising the raw values of the abiotic variable between its initial value and its collapse value. Assessors must: (i) estimate the value of the abiotic variable initial state (at the beginning of the assessment time frame); (ii) estimate the expected value in a collapsed state; (iii) measure or estimate the present or future value of the variable (i.e. at the end of the assessment time frame).

The following equations rescale an abiotic variable to a proportional change towards collapse suitable for assessing criterion C:

Relative severity (%) = (Observed or predicted decline / Maximum decline) × 100
where

Observed or predicted decline = Initial value – Present or future value
and

Maximum decline = Initial value – Collapse value

In subcriterion C2a the current state gives the initial value for the equations.

Next, assessors determine the extent of the degradation as a proportion of the total distribution of the ecosystem. With these two quantities, assessors assign a risk category using the described thresholds.

Dealing with uncertainty

Determining an initial and a collapsed value for the abiotic variable may include uncertainty that can be represented with bounded thresholds of the values of the variable. The calculation of relative severity can be repeated with both values, providing a lower and upper estimate for the risk category. Similarly, uncertainty in the extent of degradation can be assessed with the use of upper and lower estimates.

The application of criterion C assumes a functional form of decline. The simplest case illustrated above applies when there is a linear relationship between the assessment variable and the trajectory towards a collapsed state. Other scenarios are possible, for example, where collapse proceeds more slowly or more rapidly than indicated by changes in the assessment variable. In such cases a suitable transformation of the assessment variable should be used in the calculation of relative severity. To overcome uncertainty related to the shape of decline, sensitivity analyses that include estimates produced from multiple shapes of decline can provide a bounded estimate for the risk assessment outcome.

2.5.3.4
National supplementary guidelines

The above is a description of the application of criterion C in cases where quality changes can be examined through one or multiple quantitative quality variables for which there is comprehensive data. It was found during the threat status assessment of Finland's

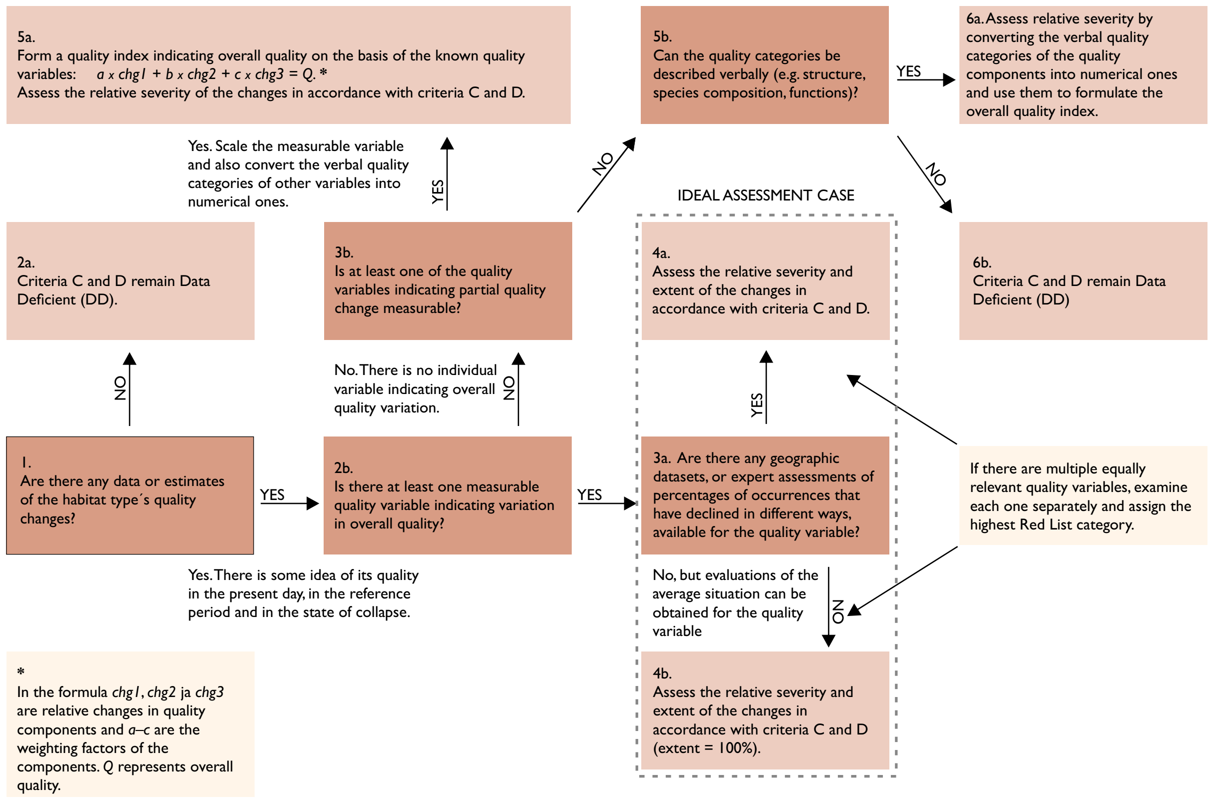

Figure 2.6. Flowchart for a variety of quality assessment situations when assessing the threat status of habitat types.

habitat types that it is not always possible to find a measurable quality variable explaining the majority of variation in overall quality. The non-application of criterion C and the biotic quality criterion D would, however, have been a poor option as in most cases there is quality data available on Finnish habitat types, in some cases even an abundance of data. This is why a decision was made in the Finnish assessment to also accept quality assessment methods deviating from the recommendations of the IUCN Guidelines. Figure 2.6 presents a variety of assessment situations where different types of data were used to depict habitat type quality changes.

In the worst case (2a in Figure 2.6), there is no data available for the assessment of the abiotic or biotic quality of a habitat type and it is not possible to infer the severity or extent of the changes through expert inputs, either. In such cases, the habitat type is classified as Data Deficient (DD) under criteria C and D.

If the overall quality of the habitat type can be represented by an individual variable, the assessment may proceed as described above in section 2.5.3.3 (4a and 4b in Figure 2.6). The starting point of the IUCN Guidelines is that there is research data available for the assessment concerning the variable representing habitat type quality. It is often the case, however, that there is no suitable quality data or that quality observations are scattered. The application principle of criterion C (or D) can still be followed if values for a relevant and measurable quality variable are produced as expert inputs (this case, too, corresponds to alternatives 4a and 4b in Figure 2.6). In such cases, the values for the variable are assessed for the present day, the reference periods and the state of collapse, and a general quantitative estimate is obtained of the relative severity of the change. Although uncertain, the estimate can be improved in the future by commencing the collection of actual data on the variable.

An example of an estimate like this could be a variable representing the overgrowth of calcareous rock outcrops, such as the average percentage of a calcareous rock outcrop occurrence covered by forest mosses or forest litter. Such data has not been collected (at least not systematically), but its evaluation is possible.

If no individual quality variable sufficiently represents the overall variation in the habitat type's quality, a summary index representing overall quality can be formulated from the known quality components (5a in Figure 2.6). The variables must together explain as much of the habitat type's overall quality variation as possible and be as independent of each other as possible. In this procedure, abiotic and biotic quality components may be combined, so the evaluation does not concern Red List categories under IUCN criterion C or D separately but, instead, a combination of them (CD).

In a case where there are three relevant quality components, the relative severity of the overall change in quality is estimated using the formula

$$a \times chg1 + b \times chg2 + c \times chg3 = Q$$

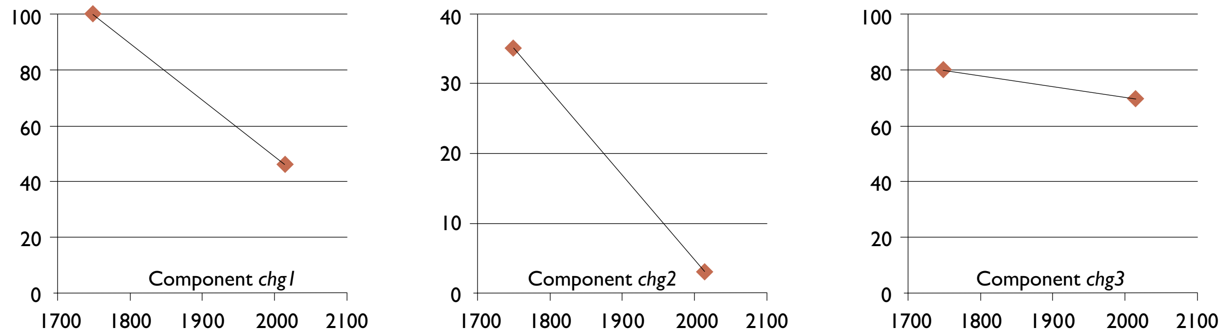

Figure 2.7. Changes in quality components in a hypothetical quality assessment case where the overall quality change of a habitat type is obtained on the basis of three components.

where *chg1*, *chg2* and *chg3* are relative changes in quality components and a–c are weighting factors the sum of which is 1. The result of the formula varies in the 0–1 or 0–100% range. The higher the Q value provided by the formula, the bigger the changes that have taken place in quality. The weighting factors are selected through expert inputs, with the guiding idea behind this being, for example, on how large a proportion of the habitat type's species changes in each component may affect.

Figure 2.7 illustrates changes in three hypothetical quality components over the 1750–2015 period. Component *chg1* has declined by 54%, component *chg2* by 91.4% and component *chg3* by 12.5%. An expert assessment is conducted to infer the weighting factors of the components. Let us say $a = 0.5$, $b = 0.4$ and $c = 0.1$ in this example, in which case the above formula is:

$0.5 \times 0.54 + 0.4 \times 0.914 + 0.1 \times 0.125 = 0.65$

The figure illustrates the relative severity of the change in a case where the state of collapse is not reached by the habitat type until the reduction in every component is 100%. The relative severity of the change – 0.65 (65%) – corresponds to the Red List category of Vulnerable (VU) under the historical time frame criteria C3 and D3.

The assessments of heath forests employed a variant of the above-described method of assessing multiple quality components. The variant is described in more detail in section 2.5.5.3.

If there is no quantitative data on a habitat type's quality changes, it may be possible to illustrate the habitat type's quality through, for example, its structure, species composition or functional features using verbal descriptions (6a in Figure 2.6). An approach like this was originally employed in the definition of forest naturalness in Northern Europe (Brūmelis et al. 2011). The aim of the quality categorisation is for changes from one category to another to be as equally spaced and mutually comparable among the various quality components as possible. Quality tables are used in assessments under criteria C and D so that, using verbal descriptions as unambiguous as possible, the most suitable quality categories are assigned for the present day, the reference period and the state of collapse. After that, the quality categories are given numerical values (0–4, half points may also be used), which are used to evaluate the relative severity of the change that has taken place. Section 2.5.5.4 presents the assessment of mesic meadows conducted in the manner described above.

2.5.4
Criterion D. Disruption of biotic processes and interactions

2.5.4.1
Theory

The persistence of biota within ecosystems depends on biotic processes and interactions. This includes competitive, predatory, facilitatory, mutualistic, trophic and pathogenic processes; mobile links; and species invasions. Biodiversity loss reduces the capacity of ecosystems to capture resources, produce biomass, decompose organic matter and recycle carbon, water and nutrients, and also reduces the stability of these functions through time (Cardinale et al. 2012). The identity of organisms within a system controls its functioning.

Feedback interactions are crucial for an ecosystem type to absorb environmental change while maintaining characteristic biota and processes. Conversely, significant disruptions to biotic processes and interactions can cause collapse, regime shifts and re-organisation into novel ecosystems (Thébault and Loreau 2005). Disruption of interactions through trophic cascades is one of five major threats to biodiversity (Diamond 1989), although non-trophic interactions also play important roles (Fontaine et al. 2005; Goudard and Loreau 2008).

2.5.4.2
Thresholds and subcriteria

An ecosystem may be listed under criterion D if it meets the thresholds for any of four subcriteria (D1, D2a, D2b, or D3), which express different levels of biotic disruption over the time frames given in Table 2.5.

Table 2.5. Subcriteria, time frames and thresholds in criterion D (IUCN 2015).

		Relative severity (%)		
	Extent (%)	≥ 80	≥ 50	≥ 30
D1. The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		
	Extent (%)	≥ 80	≥ 50	≥ 30
D2a. The next 50 years, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; OR **D2b.** Any 50-year period including the past, present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		
	Extent (%)	≥ 90	≥ 70	≥ 50
D3. Since 1750 based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
	≥ 70	EN	VU	
	≥ 50	VU		

2.5.4.3
Application

Selection of variables

Assessment under criterion D involves the same data requirements and guidelines as under criterion C, but this time concerning biotic variables. Also applying to criterion D is the decision made to increase assessment efficiency according to which, in cases where there are no observations or inferred suspicions of significant negative changes and significant threats, the habitat type can be assessed under this criterion directly as Least Concern (LC).

In other cases conceptual models provide a useful framework for selecting biotic variables linked to key ecosystem processes. A broad set of variables are potentially useful for quantifying biotic processes and associated functional declines. This includes changes in species richness, composition and dominance; relative abundance of species functional types, guilds or alien species; measures of interaction diversity; changes in identity and frequency of species movements; measures of niche diversity and structural complexity.

The same national supplementary guidelines as for criterion C (see section 2.5.3.4) apply to criterion D. In other words, the aim is to produce an assessment of quality changes even in those cases where no single relevant biotic variable indicating overall quality can be found for the habitat type. The solution may be, for example, a more comprehensive view of the quality change based on expert inputs or multiple quality variables. Assessments combining abiotic and biotic changes are recorded under criterion CD. Quality assessment methods deviating from the IUCN Guidelines are described in section 2.5.3.4 and national examples of the use of criteria C, D and CD in section 2.5.5.

Methods

The evaluation of criterion D follows the same procedure as with criterion C, but focuses on biotic variables rather than abiotic variables. Again, relative severity is calculated by range-standardising the raw values of the biotic variable between its initial value and its collapse value. Assessors must: (i) estimate the value of the biotic variable in an initial state; (ii) estimate the expected value in a collapsed state; (iii) measure or estimate the present or future value of the variable. These three quantities are then used to rescale the biotic variable to a proportional change towards collapse.

Next, assessors must determine the extent of the disruption as a proportion of the total distribution of the ecosystem. With these two quantities assessors proceed to assign a risk category using the described thresholds (Table 2.5).

2.5.5
National examples of the use of criteria C and D and their combination CD

2.5.5.1
The Baltic Sea: benthic habitats characterised by *Fucus*

Variation in the biotic quality of benthic habitats with *Fucus* is illustrated well by the Water Framework Directive (WFD) indicator lower growth limit of the continuous *Fucus vesiculosus* belt, which was used for quality assessment under criterion D (Ruuskanen 2014). The indicator correlates well with the coastal waters eutrophication rate and, accordingly, its variation also indicates the wellbeing of the bladder wrack (*Fucus* spp.) and its accompanying species (Figure 2.8).

Figure 2.9 shows the assumed and in part observed trend seen in the indicator since 1920 in a section of the Finnish coast (southwestern inner archipelago). The values of the original variable have been converted to fit within the 0–1 range and, more specifically, the figure shows the development in the indicator's Ecological Quality Ratio (EQR). The figure illustrates several factors relating to the threat status assessment of habitat types:

1. There is no historical data on the baseline value of the quality variable used. Instead, it was roughly inferred on the basis of the correlating variable. Here the baseline values for the lower growth limit of *Fucus vesiculosus* and the EQR values derived from them were inferred on the basis of water transparency data.
2. There is no data on the 1960s values of the quality variable used, so it was roughly inferred on the basis of the longer-term trend. It should be noted that in a case like this non-linear models would provide different results than the linear one. In the case of benthic habitats characterised by *Fucus*, the 1960s values are assumed to be roughly in line with the linear model, although the trend has not followed it throughout the entire period examined.
3. There is no research data on the quality variable's 'collapse value', that is the value the reaching of which would cause the habitat type's collapse. Instead, the value was selected through expert inputs. The collapse value selected for benthic habitats characterised by *Fucus* is 0.2, which is the threshold for the WFD class poor. In terms of growth depth, this corresponds to 0.8–2.2 m depending on the section of the coast. If the lower growth limit was at a depth this shallow, the bladder wrack belt would be very narrow and its existence might become impossible due to ice erosion.

The relative severity of change under criterion D1 of benthic habitats characterised by *Fucus* in the southwestern inner archipelago is 50%. As efforts were made to assess the relative severity by taking all of the observations from the area in question into account, the extent of change is regarded as being 100%. To form the basis for the habitat type's nationwide assessment under criterion D1, corresponding calculations were made for six coastal sections where benthic habitats characterised by *Fucus* occur.

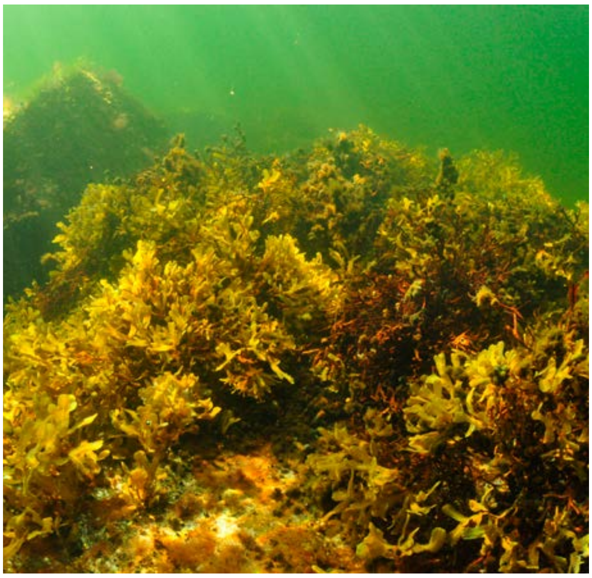

Figure 2.8. Benthic habitat with *Fucus* spp. The Water Framework Directive (WFD) indicator lower growth limit of the continuous *Fucus vesiculosus* belt correlates well with the coastal waters eutrophication rate: the clearer the water and the less filamentous algae growing on *Fucus*, the deeper *Fucus* is able to grow. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

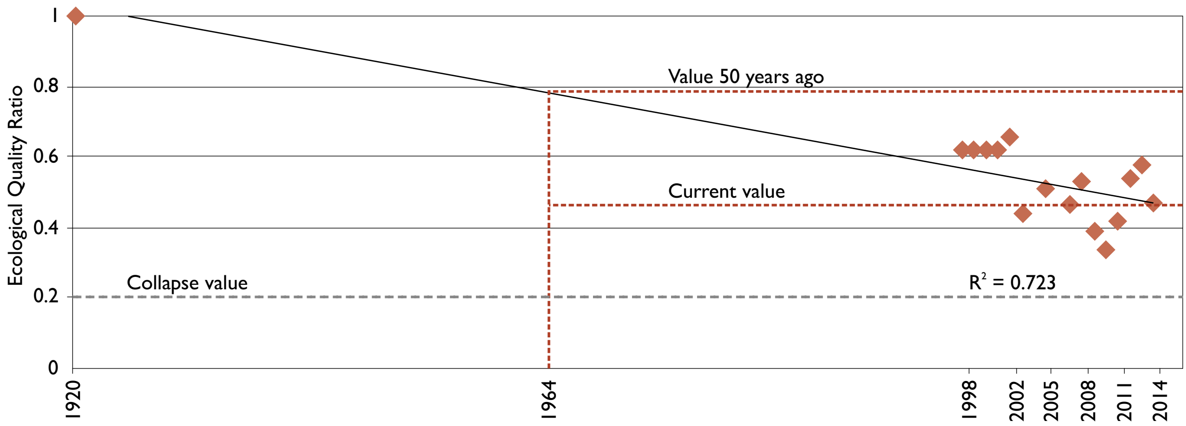

Figure 2.9. Trend of the Ecological Quality Ratio (EQR) values of the lower growth limit of the continuous *Fucus vesiculosus* belt indicator since the 1920s in Finland's southwestern inner archipelago (Ruuskanen 2014).

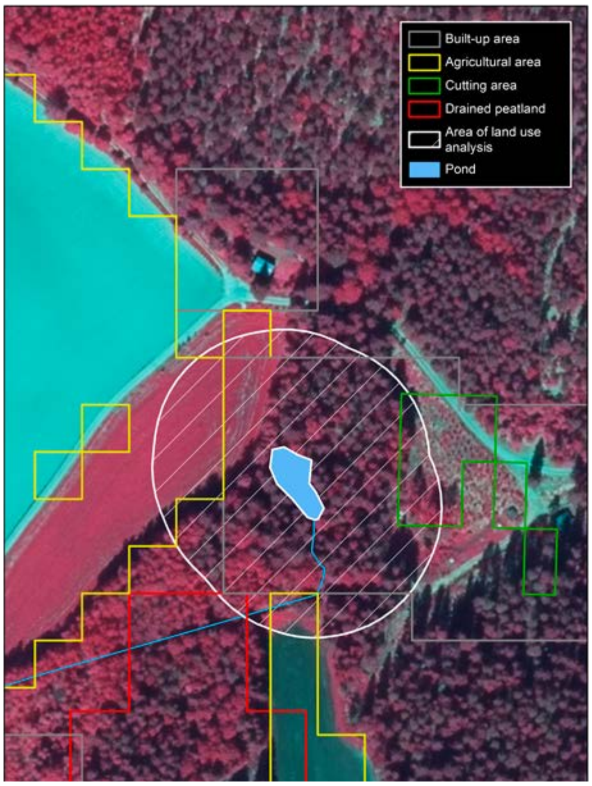

Figure 2.10. Example of examination of pond alteration based on geospatial datasets. The shaded area shows the land use analysis area around the pond and the borders in other colours mark areas in the immediate surroundings that have been altered in various ways: the grey indicates built-up areas and the yellow agricultural areas (Corine Land Cover 2012), while the green indicates a cutting area (Global Forest Change 2017: forest loss) and the red drained peatland (Mire drainage status 2011). The combined proportion of the altered immediate surroundings was assumed to usually roughly correlate with the state of the pond. Aerial photo: National Land Survey of Finland.

2.5.5.2
Inland waters and shores: ponds and lakes

Antti Lammi, Aira Kokko and Minna Kuoppala

Ponds and small lakes. In the assessment of inland water habitat types, abiotic quality changes of pond and small lake habitat types were only assessed over the historical time frame since 1750 (criterion C3). In the absence of other quality data, it was sought to identify changes in the abiotic quality of ponds and small lakes on the basis of changes of land use in their immediate surroundings. When evaluating quality changes, the percentage of land use changes was assumed to be 0% at the 1750s reference point, and a situation where 80–100% of the area of the immediate surroundings of ponds and small lakes is altered by human activity was interpreted as the theoretical state of collapse. As this geospatial analysis was in some cases found to underestimate the land use change, the relative severity of the change was corrected through expert inputs.

The examination of geospatial data on the immediate surroundings of ponds and small lakes covered an area 50 m in width for water bodies less than 1 hectare in size and 100 m in width for those of 1–10 hectares, measured outwards from the shoreline. The examination included a reasonably comprehensive range of factors relating to human activity and indicating alteration, such as changes in forest cover (Global Forest Change 2017), drainage of mires (Mire drainage status 2011) as well as agriculture and construction of artificial areas (Corine Land Cover 2012) (Figure 2.10). Illustrating forestry pressure, the Global Forest Change data included the most significant changes in forest cover in the 2000–2014 period, but it was not possible to take any forestry pressures affecting the areas over the longer time frame into account in the examination.

Different types of ponds and small lakes were examined to assess how high a percentage of the immediate surroundings of each type was, on average, altered by human activity. The higher the alteration rate, the poorer the state of the pond or small lake type is likely to be. This alteration examination does not, however, directly express the actual loading on the pond or small lake, which is why its results were only used to support expert inputs.

The usability and sources of error of the alteration examination were also evaluated in greater depth by using map data to visually examine the immediate surroundings of a total of around 200 spring, forest and mire ponds and small lakes (Kartano 2017). Comparisons of the calculations based on geographic datasets and the visual sample examinations based on aerial photography and map data showed that the analysis of available geospatial datasets underestimated the alteration rate but that there was variation between the types of ponds and small lakes. Geospatial analysis took agricultural areas and the most significant sites among artificial surfaces into account well, but roads, gardens, power lines and other small sites were at times discarded in the calculations. As anticipated, the geospatial analysis covering the whole country underestimated forest felling, too. Besides clear cutting, the visual examination paid attention to sapling stands and young cultivated stands. Drainage of peatland and mineral soils in the buffer zones of the sample ponds and small lakes was surveyed using an analysis based on narrow streams in the Topographic Database (2017). The geospatial analysis conducted on all ponds and small lakes and the visual examination produced a very similar picture of the drainage of mires. In contrast, the absence of mineral soil drainage from the geospatial analysis was a significant shortcoming especially as regards forest ponds and small lakes, as this drainage covered an average of up to 30% of the immediate surroundings of the forest ponds and small lakes included in the sample. Efforts were made to take the sources of error in the geospatial analysis into account through expert inputs when conducting the treat status assessments of the various pond and small lake types.

Lakes. Quality changes of lake habitat types over the historical time frame (C3, D3) were studied regarding most of the lake types by using ecological classification data from the 2nd River Basin Management (RBM) cycle.

Figure 2.11. Changes in the biotic quality of lakes were evaluated by utilising variables of the ecological classification used in River Basin Management (RBM), including the relative proportion of aquatic macrophyte type species. Pictured here is the alternate water-milfoil (*Myriophyllum alterniflorum*), which is a characteristic species of several Finnish lake habitat types. It is also a species sensitive to loading whose occurrence usually focuses on water bodies with phosphorus levels below 30 µg P/l. Photo: Jari Ilmonen

Historical changes were evaluated by comparing the current state of the variable examined with the reference state of the ecological classification of surface waters (Vuori et al. 2009; Aroviita et al. 2012). 'Reference state' means a value calculated using observations from reference sites of the variable (no significant loading or hydromorphological change or best remaining sites). It was deemed as corresponding approximately to reference values from the pre-industrial era.

The ecological classification variables used to evaluate changes in abiotic quality over the historical time frame (C3) were total phosphorus and hydromorphological state. Changes in biotic quality over the historical time frame (D3) were evaluated by utilising the RBM ecological classification variables of chlorophyll a, relative share of aquatic macrophyte type species (Figure 2.11), Profundal Invertebrate Community Metric (PICM) and fish biomass.

Qualitative change over the past 50 years (criteria C1 and D1) was assessed for the majority of the lake types on the basis of time series of water quality data. The variable used when examining abiotic quality change was total phosphorus and for biotic quality change chlorophyll a. In practice, data was available for around 35–40 years, so the evaluation also included expert inputs. Time series for total phosphorus and chlorophyll a were also utilised in assessments under criteria C2b and D2b (any 50-year period including the past, present and future). This means a regression model was employed with the observation data to model total phosphorus and chlorophyll a trends over the next 10 years.

When assessing the relative severity of the changes, the state of collapse used for each of the variables examined was the threshold between poor and bad state, which is the threshold between the two lowest classes on the five-class scale of ecological status classification.

There was considerable variation in the geographical and temporal coverage of the data employed in assessments of lake quality. This was taken into account when interpreting the results. If data used in assessment was deficient, expert inputs were also used or the habitat type was interpreted as Data Deficient (DD) under the criterion in question. If there were differences between the assessments produced by the various variables, the result regarded as the most reliable was used and, if deemed justified, the uncertainty of the result was expressed by providing the range of variation.

Table 2.6. Example of a threat status assessment of a heath forest habitat type (xeric heath forests) in Southern and Northern Finland under criterion D1. The weight coefficients were used when calculating the average of the figures corresponding to the variable-specific Red List categories (LC = 1, NT = 2, VU = 3, EN = 4 and CR = 5), with the Red List category assigned for the habitat type being the category corresponding to the average.

Quality variable	Weight coefficient	Southern Finland					Northern Finland				
		Present	50 years ago	Relative severity	Threat category	As a figure	Present	50 years ago	Relative severity	Threat category	As a figure
Dead wood (m^3/ha)	0.4	2.7	3.2	0.16	LC	1	8.0	14.1	0.43	VU	3
Large trees (number/ha)	0.3	0.5	1.4	0.64	EN	4	17.5	14.0	-0.20	LC	1
Deciduous trees (%)	0.3	3.7	3.3	-0.11	LC	1	1.2	3.9	0.69	EN	4
Average						1.9					2.7
Final Red List category of the habitat type						NT					VU

Table 2.7. Example of a threat status assessment of a heath forest habitat type (xeric heath forests) for the whole of Finland under criterion D1. The figure for the whole of Finland is an area-weighted average of the figures for Southern and Northern Finland (see Table 2.6), with the corresponding Red List category being the habitat type's category for the whole country.

	Area (km^2)	Red List category	As a figure	Red List category
Southern Finland	3094	NT	1.9	
Northern Finland	2334	VU	2.7	
Whole Finland			2.24	NT

2.5.5.3

Forests: heath forests

Kaisa Junninen, Tuomas Aakala, Marja Hokkanen, Kari T. Korhonen, Timo Kuuluvainen, Katja Matveinen, Katariina Mäkelä, Pekka Punttila, Sauli Valkonen, Raimo Virkkala and Jari Kouki

Changes in the biotic quality of heath forest habitat types (criterion D) were evaluated using the total volume of deadwood (m^3/ha), number of large trees (number/ha, minimum diameter at breast height 40 cm in Southern Finland and 30 cm in Northern Finland) and percentage of deciduous trees (percentage of total volume of living trees; only for criterion D1) (Figure 2.12). Figures calculated from National Forest Inventory (NFI11, 2009–2013) data were used to assess the current state. Under criterion D1, the deadwood values for the reference period were calculated using NFI9 (1996–2003) data as there is no earlier data available, while the values for large trees and percentage of deciduous trees were calculated using NFI5 (1964–1970) data. For criterion D3, the quantities of deadwood and large trees for the reference period (the 1750s) were inferred from values found in natural forests. Taken into account in this were the cooler climate, higher prevalence of forest fires and the use of timber in Southern Finland in the 1750s.

The relative severity of change was calculated, and a corresponding variable-specific Red List category was assigned, separately for each variable (Table 2.6). To determine the Red List category of the habitat type, the variable-specific categories were converted into figures (LC = 1, NT = 2, VU = 3, EN = 4 and CR = 5) and their average was calculated. When calculating the average, the weight coefficient assigned for deadwood was slightly higher (D1: 0.4 and D3: 0.6) than that for large trees (D1: 0.3 and D3: 0.4) or for deciduous trees (D1: 0.3).

The Red List categories of the habitat types for the whole of Finland were calculated as area-weighted averages of the categories assigned for Southern and Northern Finland (Table 2.7). The areas used were habitat type-specific surface areas calculated from NFI11 data.

Figure 2.12. A heath forest whose ecological quality is good features an abundance of deadwood, deciduous trees and large trees. Patvinsuo National Park, Lieksa. Photo: Jari Kouki

Table 2.8. Table illustrating variation in quality used in the assessment of mesic meadows. The table combines descriptions of abiotic and biotic quality variation and was used for assessment under the combined criterion CD. 'Minus species' mean species indicating eutrophication and reducing representativeness. GMM = graminoid mesic meadows.

MESIC MEADOWS							
	Structure		**Species**			**Functional features**	
Representativeness class	Field layer	Openness	Vascular plant species	Other species (dependent on management) characteristic of the habitat type	Minus species or invasive alien species	Grazing pressure and/or mowing efficiency	Management history
Indicators	Str2: Coverage (%) of representative meadow vegetation of total area of vegetation	Str4: Proportion (%) of open area of the habitat type's area	Sp1: Number of noteworthy and demanding meadow plant species	Sp2: Insects, birds and fungi Can be used as an additional factor if data is available	Sp3: Coverage of minus species and/or invasive alien species	F1: Grazing pressure or mowing efficiency	F2: Grazing or mowing history (duration in years)
4: excellent / target state: Fully corresponds to the definition and has the species and features characteristic of the type	Str2: Coverage of representative low- or tall-herb vegetation mainly over 60% (with the exception of GMM)	Str4: Openness 95–100%	Sp1: More than 10 (in Southwestern Finland more than 20)	Sp2: State good (4)	Sp3: Hardly any minus species, not as uniform stands, coverage under 5% (with the exception of GMM) No invasive alien species	F1: Grazing pressure or mowing efficiency: suitable and state good (4)	F2: Grazing or mowing has as a general rule continued for 50 years
3: good / slightly declined: In accordance with the definition and has the most essential species and features characteristic of the type	Str2: Coverage of representative low- or tall-herb vegetation 10–60%	Str4: Openness 90–95%	Sp1: 6–10 (in Southwestern Finland 10–20) In best sites, the number of vascular plant species exceeds 15–25 species/m²	Sp2: State fairly good (3)	Sp3: Scant occurrence of minus species, not as uniform stands, coverage max. 5–10% (with the exception of GMM) May have individual occurrences of invasive alien species	F1: Grazing pressure or mowing efficiency: suitable or highly variable	F2: Grazing or mowing has as a general rule continued for 20–50 years or management was discontinued around 10 years ago
2: significant but clearly declined: Reasonably in accordance with the definition and has some species and features characteristic of the type	Str2: Coverage of representative low- or tall-herb vegetation 5–10%	Str4: Openness 70–90%	Sp1: 3–5 (in Southwestern Finland 3–10)	Sp2: State fairly poor (2)	Sp3: Minus species may occur, coverage max. 20–50% (with the exception of GMM) Invasive alien species may occur but their coverage is not significant	F1: Grazing pressure or mowing efficiency: under- or overgrazing or mowing inefficient or too intensive	F2: Grazing or mowing has continued for less than 20 years or management was discontinued more than 20 years ago
1: not significant, badly declined (but could be rehabilitated): Not at all typical, hardly any species and features characteristic of the type	Str2: Coverage of representative low- or tall-herb vegetation under 5%	Str4: Openness 25–70%	Sp1: 1–2 species	Sp2: State poor (1)	Sp3: Coverage of minus species over 50% (with the exception of GMM) Invasive alien species cover a large part of the meadow	F1: Grazing pressure or mowing efficiency: under- or overgrazing or mowing inefficient or too intensive	F2: Grazing or mowing was discontinued around 20–50 years ago
0: Collapsed / disappeared (cannot be rehabilitated): No characteristic species or features left	Str2: No representative meadow vegetation(0%) or type species	Str4: Openness 0–25%	Sp1: None (0 species)	Sp2: Insignificant in the site / no need to take into account in inventories (0)	Sp3: Coverage of minus species 100% (only species of other habitats) Meadow colonised by invasive alien species	F1: Not grazed or mown	F2: Grazing or mowing was discontinued around 50–100 years ago

Figure 2.13. When assessing mesic meadows, quality variation in the habitat type's occurrences was divided into several components assessed, including coverage of representative vegetation, openness and grazing pressure or efficiency of mowing (see Table 2.8). Pictured here is a representative, species-rich low-herb mesic meadow in an area managed by mowing in Lieksa. Photo: Katja Raatikainen

2.5.5.4
Seminatural grasslands and wooded pastures: mesic meadows

Katja Raatikainen

It is not possible to identify changes in the overall quality of mesic meadows on the basis of research data, but there are expert inputs and partial datasets available concerning the various quality components. Table 2.8 presents a description of variation in the representativeness of meadows drawn up for the assessment of mesic meadows. In the assessment of mesic meadows, the structure, species composition and functional features of the habitat type were divided further into multiple components (Figure 2.13). The quality variation described was regarded as representing both abiotic and biotic changes, so the combined criterion CD was applied in the assessment. Expert inputs and in part also data from the Finnish protected area biotope information system (SAKTI 2017) were used to estimate the percentages of the area of mesic meadows in representativeness classes 1–4 in 2016, in the 1960s and in the 1860s (assessments for periods before this are not possible):

- 2016 – representativeness of occurrences on average close to the class *significant but clearly declined* (area-weighted average 1.8)
- 1960s – representativeness of occurrences on average between the classes *significant but clearly declined* and *good or slightly declined* (area-weighted average 2.35)
- 1860s – representativeness of occurrences on average close to the class *good or slightly declined* (area-weighted average 2.85)

When calculating the relative severity of the representativeness change, the threshold used for a state of collapse was a situation where all mesic meadows would, on average, be in the poorest class (1 = not significant, severely declined). Relative severity was calculated by relating the change that has taken place to potential maximum change:

- past 50 years (2.35–1.8) / (2.35–1) = 40.7%
- past 150 years (2.85–1.8) / (2.85–1) = 56.8%

Both assessments correspond to the Red List category of Vulnerable (CD1 & CD3: VU). The approach described above is not mathematically orthodox, but it improves the transparency of quality assessments compared with the previous assessment of Finland's threatened habitat types by breaking the assessment down into more easy-to-perceive components.

Figure 2.14. In intensively grazed areas, reindeers eat the shoots and saplings of mountain birch, preventing the renewal of mountain birch forests. Intensive grazing also reduces the lichen cover. Photo: Risto Kalliola

2.5.5.5.
Fell habitats: *Empetrum-Lichenes* mountain birch forests

Katariina Mäkelä and Jouko Kumpula

The biotic quality of *Empetrum-Lichenes* mountain birch forests (criterion D) was assessed on the basis of biomass changes (kg/ha) of reindeer lichen. Changes in lichen biomass can be used as an indicator of the biotic quality of this dry lichen-rich mountain birch forest type, as changes in lichen biomass are also reflected in the structure and renewal of the mountain birch forest (Figure 2.14). Assessments of the current state of lichen grounds were obtained through geospatial analysis where the occurrence of the habitat type (SAKTI 2017) and regionally comprehensive lichen biomass estimates interpolated from the results of a pasture inventory of the Natural Resources Institute Finland for 2005–2008 (Kumpula et al. 2009) were examined using overlay analysis.

Data on the lichen biomasses during the other criterion D reference periods in the 1960s and around 1750 (data on the 1900 situation used) was obtained in part on the basis of written data and assessments (Helle 1980; NFI3). The data was employed using the calculation formula of Kumpula et al. (2014a, b) to produce the lichen biomass estimates. The area percentages for the categories of the relative severity of change over the past 50 years (D1) and over the historical time frame (D3) were calculated on the basis of current biomass estimates in proportion to assumed earlier reference values and the value for the state of collapse (10 kg/ha) obtained through expert inputs.

2.5.6
Criterion E. Quantitative risk analysis

2.5.6.1
Theory

Criterion E can be used to list an ecosystem type by implementing models that integrate multiple mechanisms of decline and their interactions into the risk assessment. It specifies the level of risk that corresponds to each category of threat, by defining the probability of collapse and the specified time frame for Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) ecosystem types.

2.5.6.2
Thresholds

An ecosystem may be listed under Criterion E if it meets the thresholds for the criterion, a quantitative analysis that estimates the probability of ecosystem collapse as shown in table 2.9.

Table 2.9. Thresholds for the probability of ecosystem collapse according to a quantitative risk analysis in criterion E (IUCN 2015).

CR	≥ 50% within 50 years
EN	≥ 20% within 50 years
VU	≥ 10% within 100 years

2.5.6.3
Application

The probability of ecosystem collapse can be estimated with stochastic simulation models incorporating key ecosystem processes. The models should produce estimates of an ecosystem variable for which a threshold of collapse has been estimated and quantitative estimates of risks of ecosystem collapse over a 50–100 year time frame. They should also incorporate stochasticity in key processes that determine ecosystem properties and they should be applied with scenarios that represent plausible future scenarios of ecosystem dynamics.

2.5.7
Decline thresholds

The ordinal categories of risk are delimited by thresholds defined in the IUCN Red List of Ecosystems Categories and Criteria. The rationale for the criteria and ordinal categories is grounded in theory (Keith et al. 2013). However, the threshold values that delimit categories are based partly on theoretical considerations and partly on utilitarian considerations (Keith et al. 2015). Theory provides a qualitative basis for ordered thresholds for decline, but offers limited guidance for setting their absolute values.

The purpose of decision thresholds is to rank ecosystems in informative ordinal categories of risk, rather than estimate precise probabilities of collapse. Consequently, for criteria A, C and D, threshold values were set at relatively even intervals for current and future declines in ecosystem distribution or function (Vulnerable: 30%, Endangered: 50%, Critically Endangered: 80%). The range of thresholds between 0 and 100% seeks to achieve an informative rather than highly skewed ranking of ecosystems among categories. The lowest threshold for a threatened ecosystem type (30%) recognises that evidence of an appreciable decline in ecosystem distribution or function is necessary to support listing in a threatened category. These

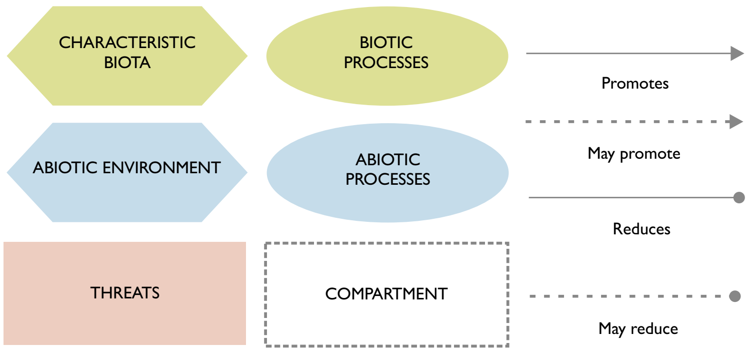

Figure 2.15. Symbols used in conceptual models depicting a habitat type's key characteristics, functional features and threats.

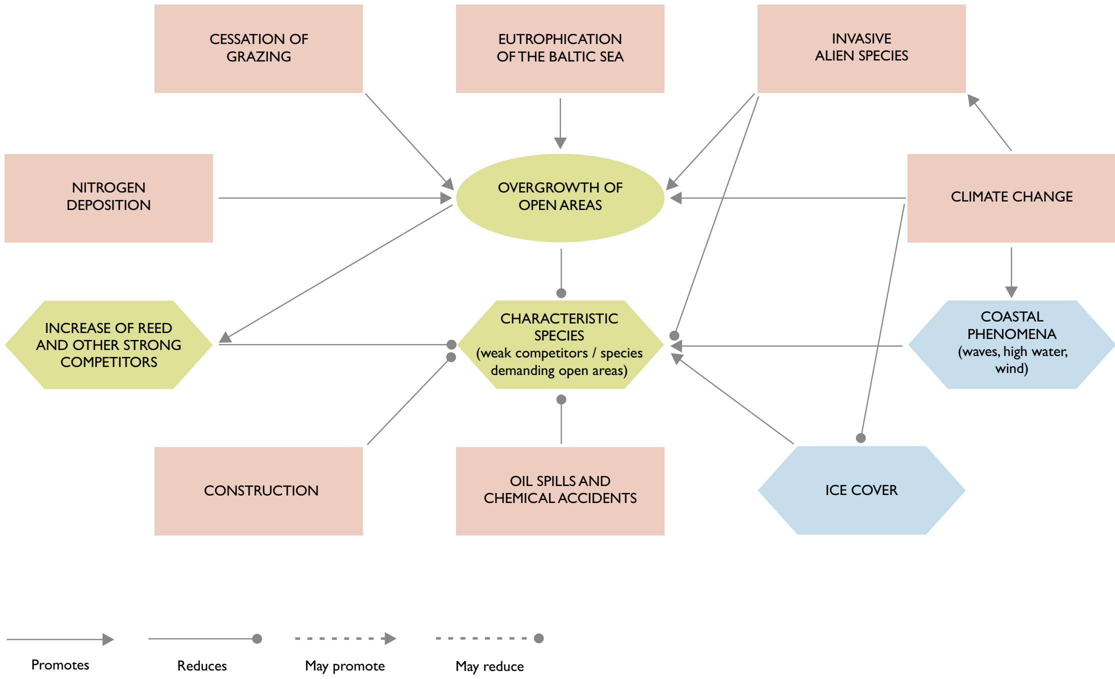

Figure 2.16. Conceptual model of the characteristics, threats and relationships of coastal stony meadows.

thresholds are consistent with thresholds for population reduction in The IUCN Red List of Threatened Species (IUCN 2001). Thresholds for historical declines are higher (A3, C3, D3; 50%, 70%, 90%) because time frames for assessment are longer.

There are no precise quantitative thresholds defined for the Near Threatened (NT) category. A habitat type is classified as NT when its decline is within 5–10 percentage points of the threshold for the Vulnerable (VU) category. For example, a habitat type whose extent of occurrence (EOO) is more than 50,000 km^2 but less than 52,500–55,000 km^2 and that qualifies for at least one of the subcriteria of criterion B is listed as NT. Under criterion C (C1 or C2), the same would apply to a habitat type with a decline in an abiotic quality variable that is less than 30% but at least 20–25% in terms of relative severity and 100% in terms of extent. An expert group considers which threshold for NT is justifiable to use, and this decision may vary by habitat type.

Under criterion B, a habitat type may be classified as NT also on the basis of it meeting the thresholds for EOO or AOO and "almost" meeting one of the subcriteria a–c.

2.5.8
Conceptual model

A conceptual model is a diagram of the most important characteristics, processes and related threats of a habitat type. A conceptual model informs the selection of relevant variables for assessing criteria C and D and the development of a quantitative model for criterion E. In addition, a conceptual model is a communication tool that summarises the habitat type's key features for those using the assessment results.

The IUCN Guidelines determine the elements of the conceptual model that can be used to create models following the same principles (Figure 2.15). Characteristic species, abiotic components, biotic and abiotic processes as well as positive and negative relationships are represented by appropriate symbols. Habitat type components functioning together can be presented as habitat type compartments.

Figure 2.16 shows an example of cause-effect models drawn up for habitat types. Examples of another type of conceptual model – state-and-transition models – can be found in the IUCN Guidelines (IUCN 2015).

Table 2.10. Abbreviations and explanations of reasons for habitat types becoming threatened and of future threats.

ADE	Atmospheric deposition of eutrophying substances	Atmospheric nitrogen deposition, chalk dust.
AGCL	Clearing for agriculture	Turning forests, mires, seminatural grasslands and wooded pastures into arable land.
CC	Climate change	Climate warming, increasing precipitation, increasing incidence of extreme weather phenomena, rising sea level, increasing atmospheric carbon dioxide level, mass occurrences of herbivores relating to warming. (Only used when clear habitat-specific grounds exist.)
CHE	Adverse chemical effects	Atmospheric and water pollution (incl. acid deposition), environmental toxins, pesticides, oil spills.
CST	Construction (on land)	Construction and construction-related earthworks and soil disposal (incl. disposal of dredged material on dry land) relating to human settlements, economic activity, transport and recreation.
DR	Ditch drainage	Also includes ditch network maintenance and later impacts of previous drainage.
EP	Eutrophication of pastures	Eutrophication of pastures and meadows, e.g. additional feeding of grazing livestock, seminatural grassland grazing in conjunction with grass, night-only grazing, fertilisation of meadows and pastures as well as eutrophying dust from crop fields.
EXT	Extraction of minerals	Extraction of soil and rock (incl. underwater), mining activities, gold panning.
F	Forestry	Forest regeneration and management measures that cannot be determined more specifically or that are not included in the following threat factors (incl. soil preparation, stump harvesting, afforestation).
FCWD	Reduction in coarse woody debris (deadwood)	Reduction in deadwood, dying trees and hollow trees.
FDS	Reduction in natural large-scale disturbances and natural succession	Includes reduction in forest fires, controlled burning and also reduction in other initial stages of natural forest succession.
FOG	Reduction in old forests and individual old trees	Including reduction in large trees.
FTS	Changes in tree species composition	Reduction in deciduous trees, Norway spruce (*Picea abies*) colonisation of herb-rich forests, reduction in deciduous (hardwood) trees.
GP	Intensive grazing pressure (such as reindeer)	Includes trampling as well as feeding on vegetation and applies to ground vegetation as well as trees. (Not used for seminatural grasslands and wooded pastures.)
GWA	Groundwater abstraction	Extraction of groundwater and utilisation of springs, incl. changes caused by lowering of groundwater table.
IAS	Invasive alien species and transplantations of species	If affects habitat type structure or functional features.
MW	Mechanical wear	Erosion or physical degradation of vegetation as well as soil and bedrock caused by human activities, e.g. trampling, off-road vehicle use or rock climbing.
OGR	Overgrowth of open areas	Overgrowth caused by the discontinuation or reduction of traditional use of pastures and meadows; incl. discontinuation of grazing, mowing, slash-and-burn agriculture, pollarding and flood irrigation and reduction in grazing pressure. (In addition to meadows, may also apply to other open areas such as sands and rock outcrops.)
PE	Peat extraction	Peat extraction for energy production, horticultural and environmental use and other possible uses and related drainage.
RTF	Random threat factors	Threat posed by random factors to habitat type occurrences. (May be used when there are very few occurrences.)
WBR	Water body regulation	Including shore erosion caused by regulation.
WEP	Eutrophication and non-toxic pollution of water	Agricultural and forestry, peat extraction, fishery, residential and industrial (non-toxic) discharges and non-point pollution (incl. impacts of water eutrophication on terrestrial shore habitat types).
WHC	Hydraulic construction	Power stations, sawmill and mill dams, port and fairway construction, dredging and clearing, channel straightening, structural alteration of littoral/riparian zone (diking, erosion protection), lake draining, reservoir construction.
WT	Waterborne transport	Impacts of propeller wash and anchorage, shore erosion caused by transport.
OTF	Other known threat factors	E.g. overfishing. (Specified in habitat-specific descriptions in Part 2 of the original Finnish report.)

2.6
Reasons for becoming threatened and threat factors of habitat types

The IUCN Guidelines recommend the use of the IUCN Threats Classification Scheme (Version 3.2, IUCN 2018) in threat status assessments of habitat types. The classification scheme was, however, originally created for species assessments and for the global level and is therefore not optimal for regional assessments of habitat types. The threat classification already applied in the 2008 assessment is used in Finland, with only minor amendments made for the second assessment (Table 2.10). The threat classification of the habitat types assessment corresponds mostly to the classification used in the assessment of threatened species in Finland (Rassi et al. 2010; Hyvärinen et al. 2019), except for certain threats not applicable to habitat types, such as hunting and gathering, hybridisation and changes in arable land.

The reasons leading into a habitat type becoming threatened are separated from the threat factors it faces in the future. In many cases the reasons that have affected it in the past and the threats it faces in the future are the same, but they may have also undergone significant changes. In addition, the significance of the reason or threat is evaluated on a scale of 1–3 as follows: 1 – rather low significance, 2 – rather high significance or 3 – high significance.

The graphs presenting the assessment results show the reasons and threats organised in the order of the overall significance of the reasons for the habitat types becoming threatened. The overall significance of a reason in the habitat type group examined was calculated as a sum total of the mentions of the reason weighted by the reason's significance.

The reasons for habitat types becoming threatened are determined for those habitat types that are classified as threatened or Near Threatened (NT) in at least one examined region of Finland. Reasons are not determined for Least Concern (LC) or, usually, for Data Deficient (DD) habitat types, with future threats possibly recorded for these, however.

The reasons for habitat types becoming threatened are recorded at the nationwide level, taking into account both historical factors and factors affecting them over the past 50 years. The significance classes of reasons and threats are given as averages and each habitat type is examined as a whole even if there are differences in significance between Southern and Northern Finland. The recording of reasons is not directly linked with the decisive criterion under which the habitat type's final Red List category is determined.

In special cases where the category is determined merely on the basis of future threats as decisive factors, the threats in question are recorded under future threats as well as under reasons for the habitat type becoming threatened.

2.7
Trends

In addition to the Red List category, the results of the threat status assessment of Finland's habitat types also contain an evaluation of the trend for the state of each habitat type. This is examined over a period of time that is considerably shorter than the future-related criteria of the IUCN method extending 50 years into the future. Evaluations of trends for the present day and the near future can, however, be utilised especially when planning actions to improve the state of threatened habitat types.

> The trends are expert assessments of whether the habitat type's state will remain stable or improve or whether it will decline due to the impacts of current measures and threats. The trend evaluations provide national additional information supplementing the IUCN assessment and are independent of Red List categories.

In this context, the 'state' of a habitat type means its overall state where quality and quantity are not examined separately. Changes in trends are based on significant and concrete changes affecting the state of the habitat type. This means that, for instance, a mere change in legislation towards a more positive direction is not sufficient to reverse the trend of a declined habitat type into a positive one. For the trend to improve, the positive impacts of the legislative amendment need to be justifiably regarded as being significant in practice, too.

The trend is marked in a separate column in the threat status assessment results tables as follows:
+ improving,
= stable,
– declining,
? unknown.

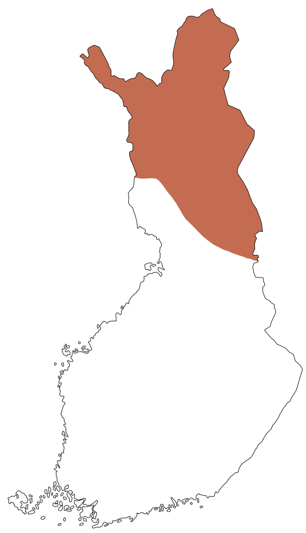

Figure 2.17. Division of Finland into subregions for the threat status assessment of habitat types. Marked in white, Southern Finland corresponds to the hemiboreal, south boreal and middle boreal forest zones and, marked in maroon, Northern Finland corresponds to the north boreal zone.

If the trend of a habitat type is provided in conjunction with the Red List category, it is given after the category abbreviation and separated by a forward slash (e.g. VU/+). The trend should not be given directly after the Red List category because the trend is a national addition not included in the IUCN method. Any improving trend should not be interpreted as indicating that no further actions to improve the habitat type's status are required in the future.

2.8
Division of Finland into subregions

In the first assessment of Finland's threatened habitat types, the threat status of each habitat type was examined not only with regard to Finland as a whole but also separately for Southern and Northern Finland. The division into subregions was regarded as necessary, as there are major differences between the regions as regards the intensity and scope of human activity. The same regional division was used in the second threat status assessment (Figure 2.17).

Threat status assessments and data examinations were conducted separately for the whole country and for Southern and Northern Finland. The assessment concerning the whole country is not an average of the assessments for the two subregions. Instead, the threat status assessment method was applied separately for each of the subregions and for the whole country.

Southern Finland comprises the hemiboreal, south boreal and middle boreal forest zones and Northern Finland comprises the north boreal forest zone. The boundary between the middle and north boreal zones follows the zone boundary revised for the regional assessment of threatened species (Ulvinen et al. 2002).

The use of these subregions or any other individual way of dividing the country is not equally suitable for all habitat types. Had resources permitted, a separate assessment concerning the middle boreal zone would have been a more informative approach for mire and forest habitat types. The division into two subregions does, however, function fairly well for most of the habitat type groups as it reflects the north-south differences in land use intensity in Finland.

The subregions based on dividing Finland into two parts are large, and the situation (abundance, alteration, whether or not threatened) of many habitat types was found to vary within the subregions. Although a single threat status assessment was provided for each subregion, some justifications and habitat type descriptions also include more detailed descriptions of regional variation in threat status or other characteristics.

2.9
Reasons for uplistings and downlistings

The assessment criteria employed in the first and second assessment of threatened habitat types differ from each other to such extent that some of the uplistings and downlistings are caused solely by differences in criteria. To ensure the comparability of the results, it is important to point out which differences are based on genuine changes in the state of habitat types and which are due to differences in assessment methods. Amendments to habitat type classification may also result in changes in Red List categories assigned.

One or multiple reasons for uplisting or downlisting are given in the threat status assessment results tables:

1: Genuine change
Threat status of habitat type changed since the 2008 assessment and Red List category consequently changed
- with a special case 1* distinguished: shift of assessment period (the assessment period of past 50 years shifted forward compared with the 2008 assessment)

2: Increased knowledge
Red List category changed due to increased knowledge

3: Change in method
Red List category changed due to reasons relating to assessment criteria, e.g. the threshold for the assignment of the Vulnerable (VU) category was raised or assignment of a lower category due to the commonness of the habitat type is not possible

4: New habitat type
No previous Red List category

5: Change in classification
Current assessment unit was, e.g., created by combining previous assessment units

6: Same category despite a genuine change
In some cases, differences in assessment criteria may conceal a genuine change.

For a genuine change, 1* is used to mark those habitat types whose Red List category has changed primarily because the assessment period of past 50 years has shifted forwards compared with the 2008 assessment. In the 2008 assessment, the past 50-year time frame began in the 1950s, whereas in the second assessment conducted ten years later it began in the 1960s. This shift is part of the IUCN method and the same principle was applied in the national assessment method used previously.

The time frame used for the examination is most relevant with regard to the Red List categories of mires, as the number of undrained mires decreased dramatically specifically around the turn of the 1950s and 1960s. Consequently, the quantity of many mire habitat types decreased more substantially over the 50-year period starting in the 1950s than over the 50-year period starting in the 1960s. This is why some mire habitat types have been downlisted despite the continued, albeit slower, decrease in their number. Under the IUCN method, this may be interpreted as a genuine change. The state of the habitat type has not, however, necessarily taken a positive turn through an increase in quantity or quality. It is therefore justifiable to distinguish these cases from such genuine change where a genuine improvement has taken place in ecological state.

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Datasets 3

3.1

Most commonly used data

Since the first assessment of Finland's threatened habitat types, new data has been produced on many poorly known habitat types. Consequently, their basic data, such as estimates of quantity and occurrence, has become more specific. However, there has not been any decisive systematic improvement in the level of habitat type data. Instead, the second assessment round still relies upon datasets compiled for other purposes that only partially answer the key assessment questions. Despite their shortcomings, these datasets were vital for the threat status assessment, which would not have been possible without the datasets produced by the various organisations. New data on habitat types has also been produced through examinations of geospatial datasets, new counts and data compilations.

This section describes a few datasets that are particularly significant or used with several habitat type groups as well as the ways in which they were used in the assessment. The information provided by data is usually best with regard to the most common habitat types and applies particularly to the current occurrence or quantity of a habitat type. Data on the rarest habitat types may also be comprehensive, and some of these are known down to the level of each occurrence. Occurrence or quantitative data is poorest with regard to many reasonably rare habitat types, many of which are missed by sample surveys while, on the other hand, they are not rare enough for their occurrences to have been systematically mapped. Only part of the datasets was suitable for identifying the current quality of habitat types, and data on changes in quantity or quality in particular was deficient.

The National Forest Inventory (NFI) is a forest resources monitoring system of the Natural Resources Institute Finland (formerly the Finnish Forest Research Institute). The first inventory took place in the 1920s (NFI1 1921–1924) and the most recent data utilised in the second threat status assessment of Finland's habitat types is from the 11th inventory conducted between 2009 and 2013. The NFIs have produced data based on systematic, nationwide sampling especially on the volume and growth of growing stock as well as on felling possibilities but also on the biodiversity of forests and mires.

The NFI sampling method has changed since the first inventories (NFI1–NFI4) involving surveys of lines through the country from southwest to southeast. Since NFI6, systematic sampling has been employed, with data collected from clusters of sample plots in the field. Since NFI8, some of the sample plots have been made permanent, enabling remeasurements to collect data on changes in, for example, forest health. The importance of the NFI for biodiversity evaluations increased in NFI9, which also covered the quantity of key habitats and deadwood, and deadwood inventories have taken place since then. The forest, mire and rock outcrop habitat type assessments utilised a naturalness variable provided by NFI11.

To facilitate the threat status assessment of habitat types, the Natural Resources Institute Finland conducted new counts based on NFI5, NFI9 and NFI11 data. Data from NFI1 and NFI8 was also used in the assessment of heath forests. Publications discussing the results of NFI3 were, as appropriate, also used in mire assessments in particular. The reason behind the need for new counts is that data on areas and other aspects was required on the subregions (Southern Finland and Northern Finland) used in the threat status assessment as well as for many assessment units (habitat types) not included in previous NFI publications. For example, the division of mires into types was a great deal more specific than that used in NFI publications. NFI results were used as a basis for threat status assessments concerning heath forests and mires in particular. For heath forests, NFI data played a key role in the evaluation of quantitative and qualitative changes. In mire type assessments, NFI data was used for quantitative assessments, and the present state of mires was assessed on the basis of forest operations data and naturalness variable data of NFI11.

A sampling-based inventory, NFI produces reliable data on common habitat types, but the problem with rare habitat types is the high standard error, as not enough occurrences of these habitat types fall within sample plots. As had been the case with the first assessment round in 2008, interpretation of NFI data still involved uncertainty regarding the extent to which changes that have taken place between inventories are genuine and the extent to which they are due to, for example, classification amendments or differences in type interpretation between measurements. In mire assessments, the utilisation of NFI data was also restricted by the differences between the forestry-related mire classification employed in the NFI and the botanical classification used in this project.

Since the completion of the 2008 assessment, the multi-source NFI data of the Natural Resources Institute Finland has gained a significant role as regards forest data. In multi-source inventories, data collected from NFI sample plots is generalised for areas falling outside the network of sample plots by using not only field measurement data but also satellite images, numerical base maps and elevation models. Multi-source NFI data was employed in, for example, evaluations of the geographic distribution of heath forests.

Habitat type inventory data of Metsähallitus (a state-owned enterprise that administers state-owned land and water areas) was an important data source for the threat status assessment. The data is currently collected in the protected area biotope information system (SAKTI 2017), which contains habitat type data on land and water areas administered by Parks & Wildlife Finland and also on the majority of current private protected areas. Habitat type data has been collected, supplemented and updated since the beginning of the 2000s especially under the Forest Biodiversity Programme for Southern Finland (METSO) extending from Southern Finland to Southern Lapland and underway until 2025. In Southern Finland, habitat type data is collected primarily through field surveys. For Lapland, the majority of the habitat type data in the SAKTI data system originates from surveys conducted in northernmost Lapland (Ylä-Lappi) and in Urho Kekkonen National Park between 1996 and 2000, which is when most inventories took place through aerial photograph interpretation. Habitat type inventories have since continued in Lapland in the 2000s, and data on Ylä-Lappi has been supplemented through field inventories of small-scale and nutrient-rich fell habitat types.

Data collected in Metsähallitus habitat type inventories is designed to meet needs relating to the management and use of nature reserves in particular. It also includes content such as evaluations of the representativeness at the time of inventory of habitat type occurrences included in habitat types of the Habitats Directive and has therefore provided valuable present-day quality data for the threat status assessment of habitat types, too. Especially in the assessment of fell habitat types, Metsähallitus data was crucially important as it covers the majority of the fell area. The SAKTI system is also linked to seminatural grassland and wooded pasture site data of the Centres for Economic Development, Transport and the Environment, so the system was the key source of data in the assessment of seminatural grasslands and wooded pastures, too. SAKTI data was also used in the assessment of shore habitat types, mires and certain forest and inland water habitat types. With regard to assessments other than those of fell habitat types and seminatural grasslands and wooded pastures, however, the usability of SAKTI data was restricted by the small area of land administered by Metsähallitus in Southern Finland.

In addition to data on state-owned and private nature reserves, the assessment of herb-rich forests utilised area data concerning herb-rich forests in state forestry areas, that is, in areas administered by Metsähallitus Forestry Ltd.

The Finnish Inventory Programme for the Underwater Marine Environment (VELMU) provides datasets that fully transformed the classification and assessment of Baltic Sea habitat types in the second assessment. Data produced in the inventory programme and related projects between 2004 and 2017 consists of more than 160,000 observation points where marine species have been studied employing methods most suitable for each site. Surveys have taken place throughout the coastal area and in all archipelago zones, with methods used including underwater video footage and diving. The focus of the programme has been on biodiversity surveys as once-off inventories. It has provided a good picture of the occurrence of most Baltic Sea underwater habitat types, but the data does not answer questions relating to changes in the state of species or habitat types.

Inventories of habitat types under the Nature Conservation Act pertain to nine rare, protected habitat types (Nature Conservation Act 1096/1996). They have been surveyed since 1998 by regional environment centres (today the Centres for Economic Development, Transport and the Environment), and inventory data is maintained by the Finnish Environment Institute. The protected habitat types are mostly forest and shore types. By 2018, around 1,650 sites fulfilling the criteria had been identified, and their combined area totals around 3,100 ha.

Habitat type inventories and boundary marking take place in accordance with the guidelines for habitat type inventories under the Nature Conservation Act (Pääkkönen and Alanen 2000). Data is collected on, for example, vegetation types, plant species, tree and shrub layer and naturalness of the sites. The inventory results are well suited for use in threat status assessments, but the inventory only covers a few habitat types. The data source was used in the assessments of forests with deciduous (hardwood) trees, herb-rich forests with hazel, pollard meadows, black alder swamps, sand beaches, seashore meadows, and dunes.

The Finnish Forest Centre's forest resources data was a source of municipality-specific area and occurrence data on herb-rich and heath forests with deciduous (hardwood) trees.

Habitat Directive reports on habitats, including map data, were used in the assessments of shore habitat types as well as seminatural grasslands and wooded pastures, among others (Finland's environmental administration 2013). This data was a significant source of information especially with regard to habitat types closely corresponding to habitats of Community interest, which include coastal dune types.

The Topographic Database of the National Land Survey of Finland (2014–2017) was utilised in various ways in the threat status assessment. Section 3.2 describes a few ways in which this data was used, and the Topographic Database played a significant role in providing baseline data for the examination of habitat type occurrences. Many of the topographic data objects, such as mires, water bodies, and rock outcrops and scree, correspond to broader habitat type groups on whose abundance and distribution the Topographic Database currently provides comprehensive nationwide basic data. The temporal dimension of the map series was also utilised in the threat status assessment: changes that have taken place in habitats and in land use were examined on the basis of maps dating back to past decades (Old printed maps 2017).

Corine Land Cover 2012 is a dataset on Finnish land cover and land use in 2012, and on changes in land cover from 2006 to 2012 produced by the Finnish Environment Institute. The data was collected as part of the EU's Copernicus GIO Land project on the basis of several different geographic datasets and satellite images. At the EU level, a uniform land cover and land use dataset was produced, with the minimum mapping unit being 25 ha. A raster dataset with 20 x 20 m^2 pixel size was produced nationally. The minimum mapping unit in the national dataset for change is 0.5 ha.

Land use and land cover in Corine Land Cover is described using a four-level hierarchy where the five main categories are artificial surfaces, agricultural areas, forests and seminatural areas, wetlands, and water bodies. Even at the most specific hierarchical level, the Corine classes are so general that they do not usually provide data on the area or distribution of units at the habitat type level. Covering the entire country, Corine has nevertheless provided useful basic data on many habitat type groups, and its more specific uses are described in the following section.

The assessment of lakes, streams and rivers utilised the environmental administration's **data on type differentiation, ecological status classification and water quality of surface water bodies.** Examinations of geographic distribution employed River Basin Management data on water bodies (Water bodies according to the Water Framework Directive 2016). When examining changes in the quality of lakes, streams and rivers, the environmental administration's water quality data and ecological classification data from the 2nd River Basin Management (RBM) cycle were utilised.

Geographic datasets of the Government of Åland were utilised in the assessment of, for example, seminatural grasslands and wooded pastures, and herb-rich forests with deciduous (hardwood) trees.

3.2

Examination of geospatial data and new data produced

Geospatial data was examined during the threat status assessment of habitat types in order to establish the number, quality and regional occurrence of certain habitat types or habitat type groups in Finland. The role played by these examinations varied in the project: for some habitat types geospatial datasets were a key source of data, as was the case with many rock outcrop and inland water habitat types, while for others they mainly provided background information. Seminatural grasslands and wooded pastures are, however, the only main group for which no new data was produced through compilations of geospatial datasets. The classification of seminatural grasslands and wooded pastures is primarily based on biological characteristics, such as vegetation structure and species composition, and the current general-purpose geospatial datasets do not contain data that is useful regarding them.

Geospatial datasets are most useful in the context of those habitat types whose classification is essentially based on factors such as soil quality, topography, rock type composition, location in relation to water bodies, or canopy cover. These factors could be examined by using data from sources including the Topographic Database (2014–2017), soil and bedrock maps, Corine Land Cover data (2012) or multi-source National Forest Inventory (NFI) data.

The potential area of forests on the land uplift coast was estimated based on Corine Land Cover 2012 data and an elevation model and the area of reedbeds by interpreting Sentinel 2 satellite images. In addition, the National Land Survey of Finland's old map data (Old printed maps 2017) and its Topographic Database (2016;) were utilised when establishing changes in the areas of open dune areas and sand beaches.

Among inland water habitat types, the classification and alteration review of ponds and small lakes were primarily based on examination of geospatial data employing, for example, soil and bedrock maps, a shoreline dataset (Shoreline10 2016), the Topographic Database (2016; 2017), Corine Land Cover data (2012), mire drainage status data (2011) and Global Forest Change data (2017). Significant new habitat type data was collected on meandering streams and rivers and on erosion banks on shores using geographic datasets and visual map analyses. Land cover and land use of streams, rivers, lakes and ponds was examined based on Corine data (2012).

Examinations of geospatial data played a key role in the assessment of mire complexes, too. Originally adapted from the Topographic Database, mire drainage data (Mire drainage status 2011) was employed in the assessment of the current state of raised bogs, aapa mires, local mire complexes, and coastal mires. In addition, data concerning mires studied, and classified in terms of their ecological state, by the Geological Survey of Finland was used in the assessment of the current state of raised bogs and aapa mires. A totally new examination of maps and aerial photographs was conducted to establish the current distribution and state of palsas and palsa mire occurrences (Salminen 2018) and to evaluate the state of sloping fens.

With regard to forest habitat types, the distribution and state of esker and dune forests were studied utilising, for example, soil and soil type data, slope aspect and gradient data as well as Corine Land Cover data (2012). Multi-source NFI data in turn was utilised as a source of information on site type, tree stand age and coniferous/deciduous tree dominance to identify the distribution of heath forest types.

The evaluation of the quantity and distribution of siliceous rock outcrop habitat types was based almost entirely on combining data from the Topographic Database (2016) and rock type data (Bedrock of Finland 1:200 000). In addition, tree stand age data from multi-source NFI was used when assessing quality changes in shady rock faces.

Already during the extensive separate work carried out before the commencement of the actual assessment phase, the mountain birch zone and open fell area – areas located north of and above the uniform coniferous forest zone (Fjell areas 2017) – were compiled into an open geospatial dataset. Primary baseline data for fell areas was provided by Parks & Wildlife Finland's habitat type inventory data (SAKTI). Other important baseline data was obtained from sources including multi-source National Forest Inventory data and the Topographic Database (2014). Data on the fell area was utilised especially when establishing the boundaries of fell habitat type occurrences but also when examining the distribution of habitat types such as fell mires and small water bodies in the fell area. To conduct the threat status assessment of mountain birch forests, the extent of birch forests destroyed by the autumnal and the winter moth (*Epirrita autumnata, Operophtera brumata*) was studied on the basis of satellite images.

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Results by main habitat type groups 4

4.1

The Baltic Sea

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Klovharun, Western Gulf of Finland. Photo: Mats Westerbom

4.1.1
Threat status of Baltic Sea habitat types

The breakdown of Baltic Sea habitat types into IUCN Red List categories is shown in Table 4.1 and Figure 4.1. For convenience, the term 'habitat type' is used below even though the sections also include three assessed habitat complexes. There are a total of 42 assessed habitat types, and 10 of them were classified as threatened (VU–CR, 24%), 4 as Near Threatened (NT, 10%), 14 as Least Concern (LC, 33%) and 14 as Data Deficient (DD, 33%).

No Baltic Sea habitat types were classified as Critically Endangered (CR). Habitat types classified as Endangered (EN) comprised benthic habitats characterised by *Fucus,* benthic habitats characterised by red algae, benthic habitats characterised by Unionidae, benthic habitats characterised by *Monoporeia affinis* and/or *Pontoporeia femorata*, and coastal estuaries. Except for estuaries, these habitat types have decreased considerably in terms of quantity, although their dominant species still remain relatively common. The reduction in benthic habitats characterised by *Fucus* brown algae and by red algae is related to eutrophication and increased turbidity. For benthic habitats characterised by Unionidae freshwater mussels, the reasons are more complex and include changes resulting from hydraulic construction, pollutants and eutrophication in estuaries and other near-shore areas with low salinity levels on which the habitat type's occurrence focuses.

Populations of dominant species of benthic habitats characterised by the benthic amphipod *Monoporeia affinis* and/or *Pontoporeia femorata* have in part collapsed over the last decades for reasons such as the increased prevalence of seafloor anoxia. At the same time, alien *Marenzelleria* spp. bristle worms have dispersed to Finland's marine areas and may have benefitted from free space created by the reduction of *Monoporeia affinis* (Eriksson-Wiklund and Andersson 2014). It should be noted that the threat status assessment of benthic habitats characterised by *Monoporeia affinis* and/or *Pontoporeia femorata* is linked with the habitat type interpretation also used in this assessment, that is, the biomass dominance of *Monoporeia affinis* and/or *Pontoporeia femorata.* In the reviews of monitoring data, benthic habitats characterised by *Monoporeia affinis* and/ or *Pontoporeia femorata* were regarded as lost as habitat type occurrences in areas where biomass dominance had shifted to *Marenzelleria* spp. or the bivalve *Macoma balthica.* The specific causes of the species changes are not known.

Coastal estuaries were classified as Endangered (EN) on the basis of historical quality changes that have taken place over the long term. The state of coastal estuaries has been deteriorated particularly by acidification of river water and by pollutants transported by river water as well as by dredging and construction in these areas. Increased water turbidity resulting from higher rates of solids in river water and, on the other hand, eutrophication has had an adverse effect on biotic communities.

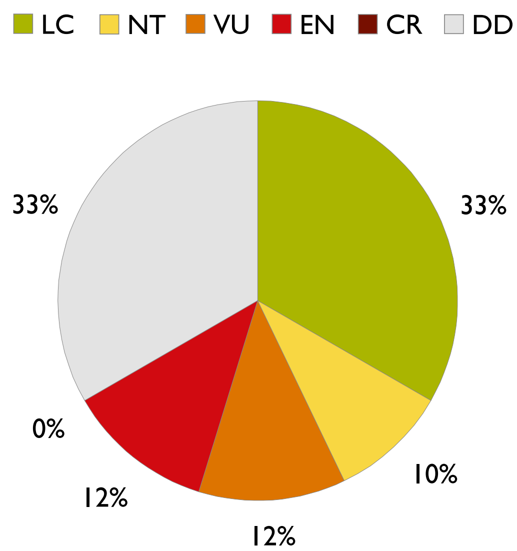

Figure 4.1. Breakdown of the Baltic Sea habitat types into IUCN Red List categories by percentage of number of habitat types (42 types).

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Table 4.1. Results of the threat status assessment of the Baltic Sea habitat types: IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment, reasons for change of category, and reasons for becoming threatened and threat factors.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
I	**The Baltic Sea**								
I1	**Hard benthic habitats characterized by perennial algae or aquatic moss**								
I1.01	Benthic habitats characterized by *Fucus*	EN	VU–CR	A2a, D1	–	VU	2, 3	WEP 3, WT 1	WEP 3, CC 2, WT 1, CHE 1
I1.02	Benthic habitats characterized by red algae	EN		A1	–	EN		WEP 3	WEP 3, CC 2
I1.03	Benthic habitats characterized by perennial filamentous algae	LC			?		4		
I1.04	Benthic habitats characterized by aquatic moss	LC			=	DD	2		WEP 2
I2	**Soft benthic habitats characterized by vegetation**								
I2.01	Benthic habitats characterized by *Hippuris*	DD		A1–A3, D1–D3	?		4		WEP 3, OGR 2
I2.02	Benthic habitats characterized by *Potamogeton* and/or *Stuckenia pectinata*	LC			=		4		WEP 2, WT 1
I2.03	Benthic habitats characterized by *Ranunculus*	NT	NT–VU	A1	–		4	WEP 3, WHC 1, WT 1	WEP 3, WHC 1, WT 1
I2.04	Benthic habitats characterized by *Zannichellia* and/or *Ruppia*	NT	NT–VU	A1	–		4	WEP 3, WT 1	WEP 3, WT 1
I2.05	Benthic habitats characterized by *Myriophyllum spicatum* and/or *M. sibiricum*	LC			+		4		
I2.06	Benthic habitats characterized by Charales								
I2.06.01	Exposed benthic habitats characterized by Charales	NT		A1	=	EN[1]	5	WEP 3, WT 2, WHC 2	WEP 3, WT 2, WHC 2
I2.06.02	Sheltered benthic habitats characterized by Charales	VU		A1	–	EN[1]	3	WEP 3, WT 2, WHC 2	WEP 3, WT 2, WHC 2
I2.07	Benthic habitats characterized by *Najas marina*	NT	LC–NT	A1	–		4	WEP 3, WHC 2, OGR 2, WT 1	WEP 3, WHC 2, OGR 2, WT 1
I2.08	Benthic habitats characterized by *Zostera marina*	VU		A1, B1,2a(ii,iii)b	–	EN	3	WEP 3, WHC 1, WT 1	WEP 3, CC 2, WHC 1, WT 1, CHE 1, OTF 1
I2.09	Benthic habitats characterized by *Eleocharis*	LC			=		4		WEP 2, OGR 2
I2.10	Benthic habitats characterized by floating-leaved plants	LC			=		4		WHC 2, WEP 2
I3	**Benthic habitats characterized by unattached vegetation**								
I3.01	Benthic habitats characterized by unattached *Fucus*	DD		A1–A3, B1–B3	?		4		WEP 3, WHC 2, CC 1
I3.02	Benthic habitats characterized by unattached *Ceratophyllum demersum*	LC			+		4		
I3.03	Benthic habitats characterized by unattached aggregations of *Aegagropila linnaei*	DD		A1–A3, B2	?		4		WEP 2
I4	**Hard benthic habitats characterized by invertebrates**								
I4.01	Benthic habitats characterized by *Mytilus*	LC			–	NT	3		CC 2, WEP 2, IAS 1, CHE 1
I4.02	Benthic habitats characterized by *Dreissena polymorpha*	NE					4		
I4.03	Benthic habitats characterized by *Amphibalanus improvisus*	NE					4		
I4.04	Benthic habitats characterized by hydroids (Hydrozoa)	DD		A1–A3, D1–D3	?		4		IAS 3, WEP 2
I5	**Benthic habitats characterized by annual algae**								
I5.01	Benthic habitats characterized by *Vaucheria*	LC			=		4		
I5.02	Benthic habitats characterized by *Chorda filum* and/or *Halosiphon tomentosus*	LC			=		4		WEP 2
I5.03	Benthic habitats characterized by filamentous annual algae	LC			+		4		

[1]Benthic habitats characterized by Charales were assessed as one habitat type in 2008.

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
16	**Soft benthic habitats characterized by invertebrates**								
16.01	Benthic habitats characterized by *Mya arenaria*	DD		A1–A3, B1, B2, D1–D3	?		4		WEP 2, EXT 1
16.02	Benthic habitats characterized by *Macoma balthica*	LC			+		4		WEP 2
16.03	Benthic habitats characterized by *Cerastoderma*	DD		A1–A3, B1, B2, D1–D3	?		4		WEP 2
16.04	Benthic habitats characterized by Unionidae	EN	VU–EN	A3	?		4	WHC 3, CHE 3, WEP 2	WHC 3, CHE 3, WEP 2
16.05	Benthic habitats characterized by infaunal polychaetes	NE					4		
16.06	Benthic habitats characterized by *Monoporeia affinis* and/or *Pontoporeia femorata*	EN	EN–CR	A1	?		4	WEP 3, IAS 2	WEP 3, IAS 2
16.07	Benthic habitats characterized by *Bathyporeia pilosa*	DD		A1–A3, B1, B2, C1–C3, D1–D3	?		4		WEP 3, EXT 1
16.08	Benthic habitats characterized by midge larvae (Chironomidae)	LC			+		4		
16.09	Benthic habitats characterized by meiofauna	DD		B2, D1–D3	?		4		WEP 2
17	**Other benthic habitats**								
17.01	Benthic habitats characterized by microphytobenthic organisms and grazing snails	DD		A1–A3, B1–B3	?		4		
17.02	Benthic habitats characterized by anaerobic organisms	LC			+		4		
17.03	Benthic habitats characterized by globular colonies of cyanobacteria or ciliates	NE					4		
17.04	Benthic shell gravel habitats	DD		A1–A3, D1–D3	?		4		WEP 2, CC 1
17.05	Benthic habitats with ferromanganese concretion	DD		A3, C1–C3, D1–D3	?		4		WEP 2, EXT 1
18	**Pelagic habitats and sea ice**								
18.01	Pelagic habitats in the northern Baltic Proper and the Gulf of Finland	DD		B1, C1, D1	?		4		WEP 3, CC 2, IAS 2
18.02	Pelagic habitats in the Bothnian Sea and the Åland Sea	DD		B1, C1, D1	?		4		WEP 3, CC 2, IAS 2
18.03	Pelagic habitats in the Bothnian Bay	DD		B1, C1, D1	?		4		CC 3, WEP 2, IAS 1
18.04	Baltic Sea seasonal ice	VU	NT–VU	C1, C2a	–		4	CC 3, WT 1	CC 3, WT 1
19	**Baltic Sea habitat complexes**								
19.01	Fladas (coastal lagoons)	VU		CD3	–	VU		WHC 3, WEP 2, WT 1, CHE 1, OTF 1	WHC 3, WEP 2, WT 1, CHE 1, OTF 1
19.02	Glo-lakes (coastal lagoons)	VU		CD3	=	EN	3	WHC 3, WEP 2, CHE 1	WHC 3, WEP 2, CHE 1
19.03	Coastal estuaries	EN		CD3	?	EN		CHE 3, WHC 3, WEP 2, CST 2, DR 1, F 1, WT 1, WBR 1, OGR 1	CHE 3, WHC 3, WEP 2, CST 2, DR 1, F 1, WT 1, WBR 1, OGR 1
19.04	Reefs	NE					4		
19.05	Sand banks	NE					4		

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Habitat types assessed as Vulnerable (VU) comprise benthic habitats characterised by the common eelgrass *Zostera marina*, sheltered benthic habitats characterised by Charales, Baltic Sea seasonal ice, and fladas (coastal lagoons) and glo-lakes (coastal lagoons). For the first two of these, the threat status was regarded as being related to a decrease in quantity caused by eutrophication, dredging and waterborne transport and, for benthic habitats characterised by *Zostera marina*, also to their restricted geographic distribution. Fladas and glo-lakes were regarded as having deteriorated mainly as regards their qualitative characteristics, and the same applied to Baltic Sea seasonal ice in the assessment of which the duration of ice cover was a key variable.

Altogether 4 habitat types – benthic habitats characterised by *Ranunculus*, benthic habitats characterised by *Zannichellia* and/or *Ruppia*, benthic habitats characterised by *Najas marina* and exposed benthic habitats characterised by Charales – were assessed as Near Threatened (NT). Species and species aggregates dominant in these habitat types have extensive distribution areas yet tolerate eutrophication rather poorly. They suffer both from turbidity caused by eutrophication and from the competitive advantage gained by species that are more tolerant of eutrophication. The adverse effects of waterborne transport and hydraulic construction focus particularly on the most shallow and near-shore occurrences of the habitat types.

Habitat types assessed as Least Concern (LC) are mainly those dominated by species that benefit from eutrophication, such as benthic habitats characterised by filamentous annual algae as well as benthic habitats characterised by *Vaucheria*, by *Myriophyllum spicatum* and/or *Myriophyllum sibiricum* and by unattached *Ceratophyllum demersum*. In eutrophic waters, fast-growing species colonise new sites efficiently and suppress slower-growing, often perennial species when competing for light.

Although data on Baltic Sea habitat types has improved considerably in recent years, the relative proportion of Baltic Sea habitat types classified as Data Deficient (DD) in this assessment – 33% – illustrates how scattered and insufficient our knowledge of underwater habitats still is. The coarse-grained distribution and ecology of many species determining habitat types are known well, but the availability of comparisons of interspecific biomass ratios required to distinguish habitat types and of systematic monitoring required for assessments is still low. Both seasonal and annual population fluctuations are high in many species, and it is difficult to reliably determine the status of a species as being the dominant species in a multi-species community. For these reasons, habitat types such as benthic habitats characterised by meiofauna were classified as DD. The high cost of sampling, on the other hand, is one reason behind the deficiency of data on, for example, zoobenthos-dominated sandy habitat types (including benthic habitats characterised by the amphipod *Bathyporeia pilosa* and those characterised by the soft-shell clam *Mya arenaria*). This is because obtaining reliable data often requires diver-collected samples and their screening. Data was deficient for habitat types consisting of loose-lying *Fucus* spp. or the lake ball *Aegagropila linnaei* as regards the number of observations, permanence of occurrences and evaluation of changes in quantity.

Criterion-specific results and criteria decisive for the final IUCN Red List categories

In the assessment of the threat status of Baltic Sea habitat types, the utilisation rate of criteria A and B was to some extent higher than that of the other criteria (Figure 4.2). In practice, this means that data on quantitative changes in habitat types (criterion A) or in their distribution or occurrence area size (criterion B) was available and utilised more often than that on their qualitative changes (criteria C and D).

Reduction in quantity (criterion A) was at least one of the bases for the determination of the final IUCN Red List category for all threatened and Near Threatened (NT) habitat types apart from habitat complexes and Baltic Sea seasonal ice (Table 4.1). In a couple of cases, the same category was assigned on the basis of multiple criteria. In contrast, the categories for Baltic Sea seasonal ice, fladas and glo-lakes and coastal estuaries were determined solely on the basis of quality criteria as the decisive criteria (criterion C and combined CD).

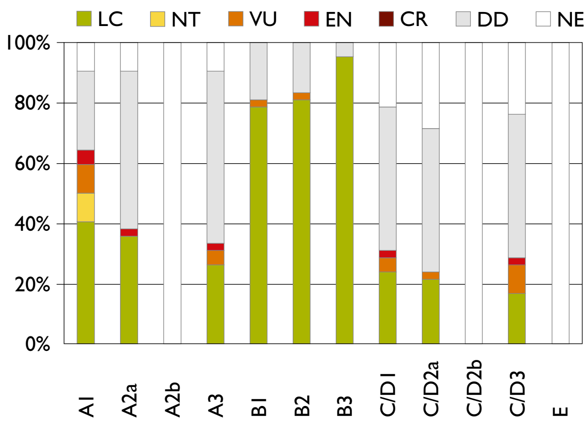

Figure 4.2. Baltic Sea habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria (42 types). The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question.

Trends

The trend for a total of 10, or almost a quarter (24%), of the Baltic Sea habitat types assessed was regarded as still declining, for 8 as stable (19%) and for 6 as improving (14%), while for as many as 18 (43%) of the habitat types the trend could not be assessed.

Examples of habitat types assessed as undergoing a declining trend include benthic habitats characterised by *Fucus* brown algae, red algae, *Ranunculus* aquatic plants and *Zostera marina* as well as Baltic Sea seasonal ice and fladas (coastal lagoons). In most cases this was attributed to the continued eutrophication process and, for Baltic Sea seasonal ice, the likely progress of climate change.

No trend could be assessed for Data Deficient (DD) habitat types. The trend was also regarded as unknown for habitat types such as benthic habitats characterised by *Monoporeia affinis* and/or *Pontoporeia femorata*, benthic habitats characterised by Unionidae as well as coastal estuaries. For benthic habitats characterised by *Monoporeia affinis* and/or *Pontoporeia femorata*, the uncertainty involves issues including the dispersal of *Marenzelleria* spp. and, on the other hand, possible cyclical population fluctuations of *Monoporeia affinis*, whereas for benthic habitats characterised by Unionidae as well as coastal estuaries there are uncertainties relating to the sufficiency of water protection measures to improve the state of river waters.

The near-future trend for the 6 habitat types benefitting the most from eutrophication was assessed as improving as there is no rapid reversal in sight for eutrophication.

4.1.2
Reasons for becoming threatened and threat factors

The factor with the most extensive impact threatening underwater habitat types is the persistent **eutrophication of the Baltic Sea** (WEP) (Figure 4.3), which was determined as the most important reason for almost all of the assessed habitat types assessed as becoming threatened (Table 4.1). Eutrophication means enhanced primary production by plants caused by increased availability of nutrients. Symptoms of eutrophication in water bodies include mass occurrences of phytoplankton and cyanobacteria (algal blooms), increased turbidity, benthic siltation, anoxia in near-bottom water caused by excessive organic loading and the resulting re-release of nutrients into water (internal loading), increased abundance of epiphytes and near-shore filamentous algae (Figure 4.4) and the expansion of reedbeds on the coastline. Eutrophication also changes the living conditions of algae, hydrophytes, zoobenthos and fish and results in changes in the abundance ratios of groups of organisms.

The Baltic Sea is burdened particularly by nutrient input from river drainage basins, with a significant proportion of this originating from agriculture. Other key sources of load include municipal and industrial wastewater discharges. Eutrophication is intensified by internal loading, in other words, the re-release of nutrients from bottom sediments in anoxic/hypoxic bottoms. Fish farms cause local increases in eutrophication. The strongest impacts of eutrophication can be seen in the Archipelago Sea and the Gulf of Finland. In these areas, hypoxia or anoxia is a widespread problem in deep bottoms and the increased abundance of epiphytes has suppressed habitat types of more shallow waters, such as those characterised by *Fucus*. Fish fauna has also suffered from reductions in the number or size of benthic spawning areas due to above-mentioned reasons. Changes in vegetation resulting from eutrophication have contributed towards,

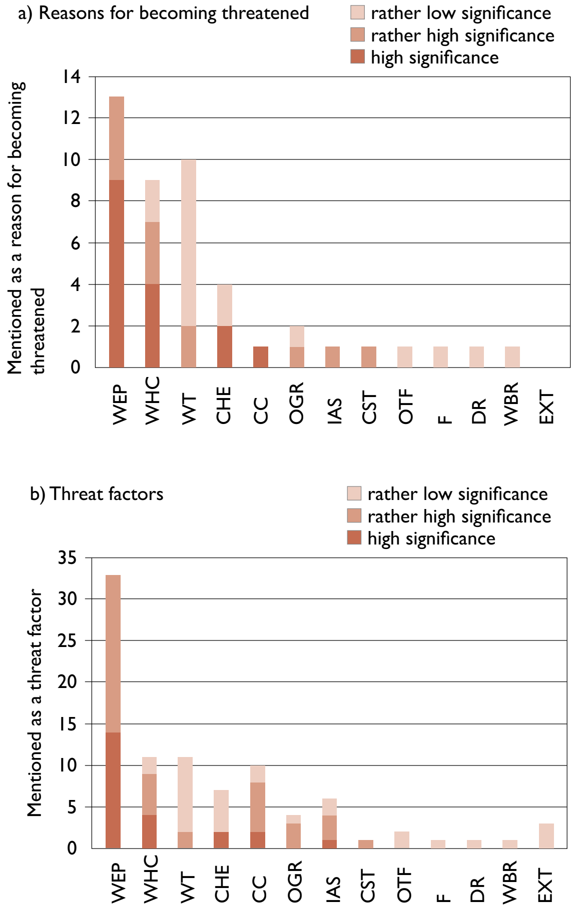

Figure 4.3. Reasons for becoming threatened (a) and threat factors (b) of Baltic Sea habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

for example, the increasing threat status of charophyte (green algae) meadows.

Although some habitat types may benefit from a slight increase in nutrient levels, they also suffer from excessive and prolonged eutrophication. For example, *Mytilus* mussel communities may benefit from plankton production accelerated by slight eutrophication and the consequently improved access to food. However, excessive eutrophication results in increased water turbidity, boosts epiphytes and causes siltation and oxygen deficiency in the benthic zone, which have adverse effects on this habitat type, too.

Hydraulic construction (WHC) and waterborne transport are also regarded as significant reasons for underwater habitat types becoming threatened (Figure 4.3). Coastal areas and fairways are made deeper through dredging (Figure 4.5) and widened by using methods as intensive as rock blasting. Dredged material is dumped in shallow marine areas, too. The natural succession caused by post-glacial land uplift is interfered with when flada or coastal lagoon mouths are widened to improve sea access. Wind farm construction

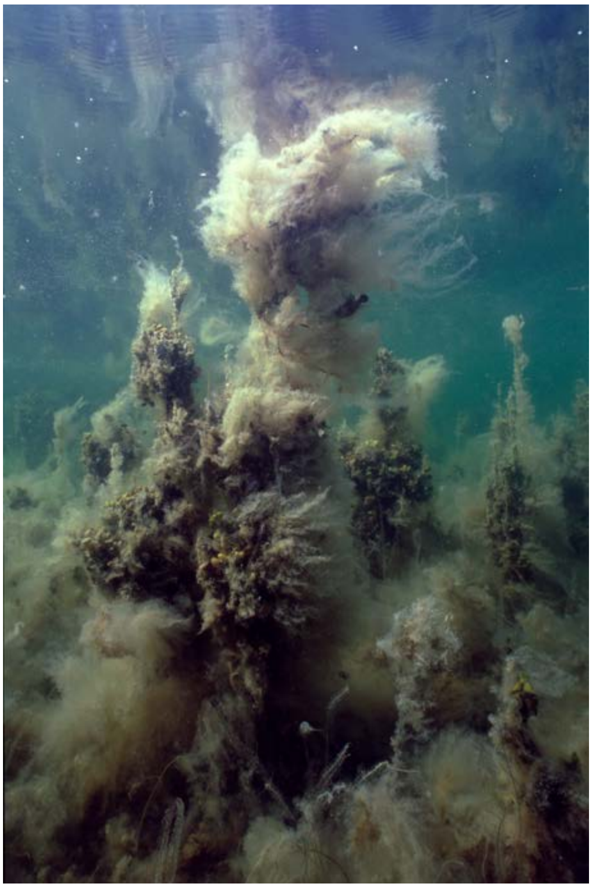

Figure 4.4. Bladder wrack (*Fucus vesiculosus*) stands suffering from excessive growth of filamentous algae in the Archipelago Sea. Photo: Visa Hietalahti

is a potential new growing threat to some underwater habitat types. Construction and dredging directly destroy habitat types on sites where these activities take place (Figure 4.6), but they also increase turbidity, the impacts of which are reflected across broader areas.

The volume of **waterborne transport** (WT) is increasing all the time in the Baltic Sea, and this has multiple impacts on the natural environment. Propeller wash and waterjet propulsion from boats and ships that are becoming increasingly large in size resuspend benthic sediments and nutrients bound up in them. This worsens eutrophication and reedbed expansion, particularly in shallow water areas. The erosion effect of waterborne transport focuses particularly on the shallow littoral zone and has a local impact on habitats such as fladas. The wash impact of large vessels also extends to dry land as waves generated by them wash off fine-grained sediments from habitats such as coastal gravel, shingle and boulder shores and destroy coastal vegetation and its natural zonation. Emissions and discharges from large passenger vessels to air and water also cause eutrophication in the Baltic Sea.

Other reasons for Baltic Sea habitat types becoming threatened include adverse chemical effects, climate change, overgrowth of open areas, and alien species (Figure 4.3, Table 4.1). **Adverse chemical effects** (CHE) focus particularly on coastal estuaries, fladas and glo-lakes (coastal lagoons) and habitat types occurring in shallow bays. Large quantities of pollutants have accrued over the past decades in sediments of coastal estuaries, and their biotic communities also suffer from river water acidification in Ostrobothnia especially. Shallow and sheltered bays with low rates of water exchange are particularly sensitive to changes in land use in the drainage area.

The impacts of **climate change** (CC) on underwater habitat types are multiple and in part still unforeseeable, but they may be visible extensively across the entire marine area. Global warming affects the North Atlantic Oscillation – fluctuations in the difference of atmospheric pressure at sea level that move extensive air masses – which causes variability in winter precipitation and temperatures in the North Atlantic region. Climate change is also likely to affect precipitation rates throughout the Baltic Sea catchment area and the inflow of saline water pulses into the Baltic Sea. Impacts on salinity levels and water stratification are difficult to forecast, and there is a great deal of variation between the various parts of the Baltic Sea basin. (BACC Author Team 2015)

With low-pressure weather events gaining strength, water level fluctuation is likely to become stronger and storm floods increase (BACC Author Team 2015). The rising sea level may in part cancel the effect of post-glacial rebound and disturb the natural progress of succession on the land uplift coast. As water and air become warmer, storms will be stronger and coastal phenomena more intense, which may have impacts particularly on habitat types occurring in shallow water.

Milder ice winters will also intensify the impacts of eutrophication on aquatic ecosystems if the shore-shaping and vegetation-scouring impact of ice is reduced or disappears altogether. In addition, the shortening of ice winters and the earlier start of the thermal growing season will have adverse effects on underwater habitat types, too (BACC Author Team 2015). Warming boosts primary production, which may have an impact promoting internal nutrient loading and algal blooms also in northern Baltic Sea. Reduced surface water transparency affects submerged hydrolittoral habitat types by narrowing the substrate area suitable for photosynthesising plants.

Global warming may also facilitate an increased abundance and dispersal of alien species. Even without climate change, the spread of **invasive alien species** (IAS) in the Baltic Sea is a threat that has already persisted for decades. Dozens of invertebrate alien species with significant ecological and economic impacts have already been transported to our coastal waters in ship ballast water. In the species-poor waters of the Baltic Sea, alien species may have a major impact by causing changes to communities. Zoobenthic communities in particular have been altered due to the introduction of alien species. Among the reasons for becoming threatened and threat factors of Baltic Sea habitat types, alien species are mentioned in

Figure 4.5. Aerial photography shows clearly how shores and fairways are dredged deeper in shallow bays to cater for leisure-time residential needs in particular. Source: National Land Survey of Finland.

contexts including competition with the bay barnacle (*Amphibalanus improvisus*), the hydroid *Cordylophora caspia* and *Marenzelleria* spp. bristle worms.

Declining coastal grazing (OGR) and in part also the occurrence of eutrophication cause reedbed expansion in shallower waters and at the same time reduction of certain coastal habitat types. Habitat types such as shore meadows, swamps and forests may occur in the extensive flooded areas of coastal estuaries, which is why the reasons for coastal estuaries becoming threatened and their threat factors include **ditch drainage** (DR), **forestry** (F) and **water body regulation** (WBR).

4.1.3
Comparison with previous assessment

The results of this assessment are not directly comparable with the previous one (Mäkinen et al. 2008) because both the classification of habitat types and the assessment method have changed. Of the 12 habitat types of the previous assessment, only benthic habitats characterised by *Fucus*, benthic habitats characterised by *Zostera marina*, benthic habitats characterised by aquatic moss and benthic habitats characterised by *Mytilus* and, in broad outlines, benthic habitats characterised by red algae remained unchanged in the classification, whereas the other habitat types have been divided into a larger number of habitat types and assessed as separate units in this assessment. At the habitat complex level, fladas, glo-lakes and coastal estuaries also remained unchanged, but in the previous assessment these were included in the main group of coastal habitat types.

Benthic habitats characterised by *Fucus* were uplisted from Vulnerable (VU) to Endangered (EN), but the reasons for this reclassification were increased availability of data and change in the assessment method rather than any significant deterioration of the habitat type over the past decade. The downlisting of benthic habitats characterised by *Zostera marina* and glo-lakes (coastal lagoons) from Endangered (EN) to Vulnerable (VU) was not caused by any genuine improvement in their state but by a change in method.

The amount of data available for the assessment of benthic habitats characterised by aquatic moss increased clearly during the assessment period, and the IUCN Red List category changed from Data Deficient (DD) to Least Concern (LC). Benthic habitats characterised by aquatic mosses are most common in the Bothnian Bay, where the rate of eutrophication has been lower than in other coastal areas of Finland. A change in method was in turn the reason why benthic habitats characterised by *Mytilus* were downlisted from Near Threatened (NT) to Least Concern (LC). Blue mussels (*Mytilus trossulus*) tolerate eutrophication relatively well – they may even benefit from occasional slight increases in nutrient levels – and the main occurrence area of blue mussel colonies is in the open outer archipelago where eutrophication rates have been lower than in areas closer to the shore.

Benthic habitats characterised by Charales were assessed as one habitat type in the previous assessment. In this assessment, open single-species meadows formed mainly by the rough stonewort (*Chara aspera*) were separated from sheltered, layered meadows dominated by, for example, the coral stonewort (*C. tomentosa*). Both habitat types were assessed this time as being less threatened than benthic habitats characterised by Charales were in the previous assessment, but the reason for this change was due to changes in classification and method, not to any improvement in their state.

Glo-lakes (coastal lagoons) were downlisted from Endangered (EN) to Vulnerable (VU) owing to a different method used to assess change in quality, although their state had not improved between the assessments.

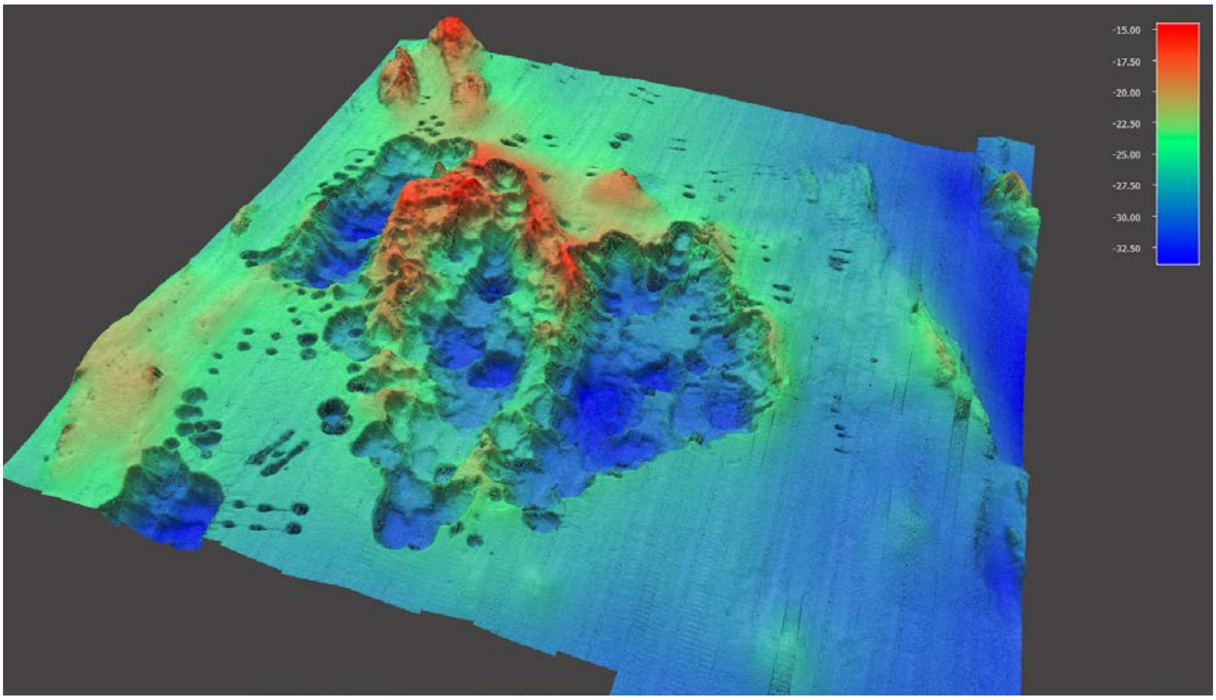

Figure 4.6. Local species are also lost with the benthic material removed by dredging. Benthic habitats characterised by *Zostera marina* and/or Charales must be taken into account in particular when dredging sandy and gravel bottoms. The multibeam echosounder image illustrates seafloor topography following gravel extraction off Helsinki in an area of around 1.5 km x 1.5 km. A suction dredger was used to extract gravel, and the impacts of the suction pipe are visible in the bottom sediment as clearly defined holes. The vertical exaggeration of the depth scale is six times. Source: Geological Survey of Finland.

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4.2

Baltic Sea coast

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Örskärs ören, Parainen. Photo: Terhi Ryttäri

4.2.1
Threat status of coastal habitat types

A total of 39 Baltic Sea coastal habitat types and 6 habitat complexes were assessed (Table 4.2). The general concept 'habitat type' is used below to refer both to habitat types and to habitat complexes. Figure 4.7 shows the breakdown of all of the assessed habitat types into Red List categories and Figure 4.8 their more specific breakdown by main group.

Of the coastal habitat types, 58% were assessed as threatened (VU, EN or CR), 15% as Near Threatened (NT) and 27% Least Concern (LC). No habitat types were classified as Data Deficient (DD).

Habitat types assessed as Critically Endangered (CR) comprised fixed coastal dunes with *Empetrum nigrum* (brown dunes) and dunes with deflation surfaces. Altogether 3 habitat complexes were assessed as being Endangered (EN): natural forest succession series of the land uplift coast, developmental series of coastal dunes, and Baltic esker islands; and the number of habitat types classified as EN was 9. These include coastal sand beaches, embryonic shifting dunes, drift lines with *Fucus* and, among primary succession forests, most types dominated by the Norway spruce (*Picea abies*), such as coastal spruce-dominated herb-rich heath forests. Classified as Vulnerable (VU) were the habitat complex of islets and cliffs with bird colonies and 11 habitat types, including several dune types, coastal scrubs with *Myrica gale* and coastal forests such as coastal mesic deciduous-dominated herb-rich forests.

There is 1 Near Threatened (NT) habitat complex along with 6 NT habitat types. These include coastal stony meadows, coastal reedbeds with *Schoenoplectus* and *Bolboschoenus maritimus* and coastal rock pools,

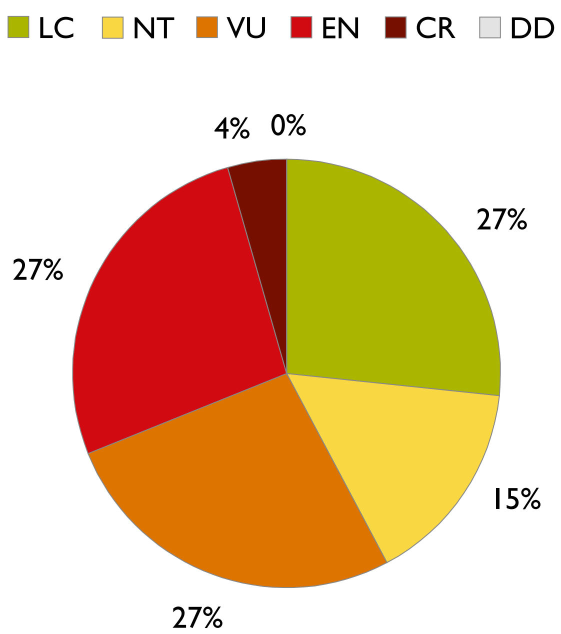


Figure 4.7. Breakdown of Baltic Sea coastal habitat types into IUCN Red List categories by percentage of number of habitat types (45 types).

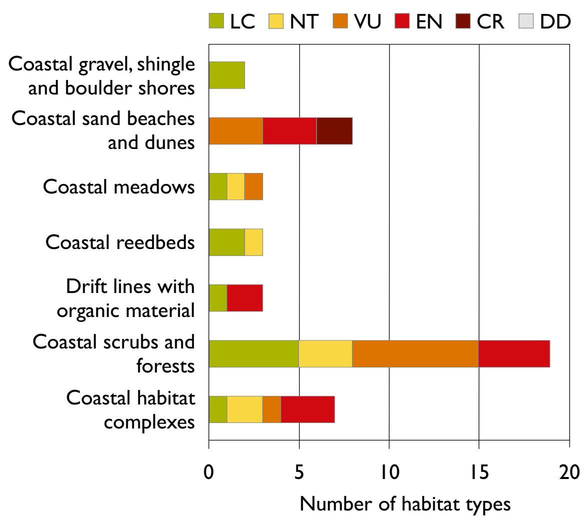


Figure 4.8. Breakdown of Baltic Sea coastal habitat types into IUCN Red List categories by main group of coastal habitats. Coastal rock pools are included in the coastal habitat complexes.

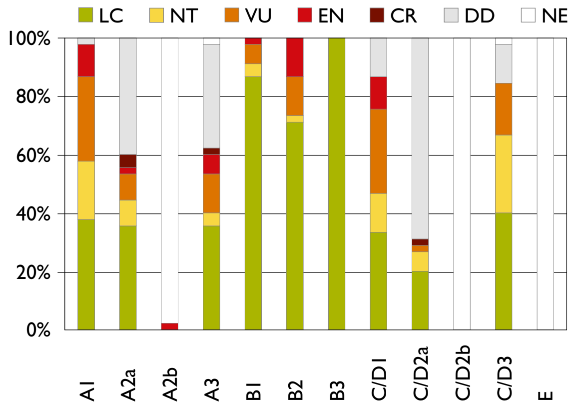


Figure 4.9. Coastal habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria (45 types). The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question.

the quality of which is likely to be deteriorated by eutrophication and the future of which may be affected by climate change.

Also classified as NT were coastal alder (*Alnus* spp.) dominated moist herb-rich forests and barren islands succession series of the land uplift coast. A total of 11 habitat types and 1 habitat complex, islands and islets in the outer archipelago, were classified as Least Concern (LC). Examples of LC habitat types include all stone shore types, reedbeds benefitting from eutrophication and drift lines with reed material created from them, and various coastal *Salix* thickets and scrub types that were not regarded as facing any significant threats. No coastal habitat types were assessed as Data Deficient (DD) or Collapsed (CO).

Criterion-specific results and and criteria decisive for the final IUCN Red List categories

Criteria A, B and CD were used frequently in the assessment of the threat status of Baltic Sea coastal habitat types (Figure 4.9). In the determination of the final IUCN Red List category, changes in quantity (criterion A) and quality (criterion CD) were equally significant, whereas the rarity-related criterion B was decisive in determining the category for a smaller proportion of assessments (Table 4.2). In most cases, the assignment into the same category was made on the basis of more than one criterion.

As regards changes having taken place in coastal habitat types, the past period of 50 years was more important in determining the Red List category than the coming 50 years or a longer-term historical review. Changes in quantity or quality in the past 50 years provided the grounds for the Red List category of more than 70% of threatened or Near Threatened (NT) habitat types, while the category assignment was based on projected future changes or assessed changes over a historical time frame for 20–30% of threatened or NT habitat types.

Trends

Of the Baltic Sea coastal habitat types, 24% were regarded as having a stable near-future trend, 64% a declining and 11% an improving one. Examples of those assessed as undergoing a stable trend include coastal tall-herb meadows and two habitat types common on the land uplift coast, coastal scrub with *Hippophaë rhamnoides* and coastal *Salix* thickets. Habitat types assessed as still declining included coastal sand beaches and all dune types, the overgrowth of which is likely to progress further in the future, too. Further decline of unprotected sites is caused also by construction and forestry. Habitat types assessed as undergoing an improving trend are coastal reedbeds with *Phragmites australis* and deciduous-dominated forest stands in the outer archipelago, which benefits from factors including reduced grazing.

4.2.2 Reasons for becoming threatened and threat factors

Baltic Sea coastal habitat types can be divided into open ones and those with scrub and/or forest. The reasons for becoming threatened and the threat factors of these are presented separately below.

Baltic Sea water quality plays a key role as regards the state of the coastal habitat types. **The eutrophication of the sea** (WEP) has had a strong impact on many on-shore habitat types (Figure 4.10a). Eutrophication has resulted in reedbed expansion and other overgrowth in open coastal habitat types including naturally open wave- and wind-maintained sand beach and dune areas. Algal masses drifting ashore (Figure 4.11) in turn provide a substrate for the common reed (*Phragmites australis*) and other perennial vegetation, which over time facilitates the increased scrub- and tree-dominance of coastal sites. Overgrowth can also be seen in upper parts of dunes in the form of increased vegetation and denser tree stands. Reedbed expansion resulting from eutrophication is visible in all types of soft-bottom shores, particularly in sheltered bays. Changes in vegetation are in turn reflected in bird fauna and other species. Overgrowth has also been accelerated by the **atmospheric deposition of eutrophying substances** (ADE) and simultaneous **reductions in coastal grazing and mowing** (OGR). Eutrophying deposition from mainland sources has been successfully reduced (Bartnicki et al. 2018), but no similar trend has been observed in nitrogen oxide emissions to air from maritime transport (Johansson and Jalkanen 2017). Eutrophication and the deterioration of Baltic Sea water quality also explain the reduction in the number, size and quality of drift lines with *Fucus*, which used to be large. Increasing amounts of reed material are being mixed with drift lines with *Fucus*, making the habitat poorer in quality for the biotic community of these drift lines than that of pure drift lines with *Fucus*.

Table 4.2. Results of the threat status assessment of the Baltic Sea coastal habitat types: IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment, reasons for change of category, and reasons for becoming threatened and threat factors.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
R	**Baltic Sea coast**								
R1	**Coastal gravel, shingle and boulder shores**								
R1.01	Coastal stone and boulder shores	LC			=	LC			CST 1, CHE 1, WEP 1
R1.02	Coastal gravel and shingle shores	LC			=	LC			CHE 1, WEP 1, IAS 1
R2	**Coastal sand beaches and dunes**								
R2.01	Coastal sand beaches	EN		A1, A2a, A2b, CD1	–	EN		WEP 3, MW 3, CST 3, ADE 2, IAS 2, EXT 1	WEP 3, CC 3, MW 3, IAS 3, CST 3, ADE 2, WHC 2, WT 2
R2.02	Embryonic shifting dunes	EN		A1	–	EN		MW 3, WEP 2, ADE 2, CST 1, WT 1	MW 3, WEP 2, CC 2, ADE 2, CST 1
R2.03	Shifting dunes with *Leymus arenarius*	VU		B2a(i,ii,iii)b, CD1	–	VU		MW 3, ADE 2, IAS 2, WEP 2, CST 2, EXT 1	MW 3, IAS 3, ADE 2, WEP 2, CC 2, CST 1
R2.04	Fixed coastal dunes with herbaceous vegetation (grey dunes)	VU		A1, B2a(i,ii,iii)b, CD1	–	VU		MW 3, CST 3, ADE 2, EXT 1	MW 3, ADE 2, CC 2, CST 1, IAS 1
R2.05	Fixed coastal dunes with *Empetrum nigrum* (brown dunes)	CR		A2a, CD2a	–	VU	1	MW 3, CST 2, ADE 2, F 1, OGR 1	MW 3, ADE 2, CST 1, F 1, OGR 1, CC 1
R2.06	Humid dune slacks	EN		B2a(i,ii,iii)b	–	EN		DR 2, MW 2, OGR 2, ADE 2	OGR 2, ADE 2, DR 1
R2.07	Coastal wooded dunes	VU		A1, A2a, B2a(i,ii,iii) b, CD1	–	VU		F 3, CST 3, MW 2, EXT 1, ADE 1	F 3, CST 3, MW 2, ADE 1, EXT 1
R2.08	Dunes with deflation surfaces	CR		A2a, A3	–		4	OGR 3, ADE 2, CST 2	OGR 3, ADE 2, CST 1, CC 1
R3	**Coastal meadows**								
R3.01	Coastal stony meadows	NT	NT–VU	CD1, CD2a	–	NT		WEP 3, ADE 2, CST 1, OTF 1, WT 1	WEP 3, CC 3, ADE 2, CST 2, CHE 2, WT 1
R3.02	Coastal epilitoral meadows	VU	VU–EN	A2a, CD1	–		4	WEP 2, ADE 2, OGR 1, IAS 1	WEP 2, ADE 2, IAS 2, OGR 1
R3.03	Coastal tall-herb meadows	LC			=		4		
R4	**Coastal reedbeds**								
R4.01	Coastal reedbeds with *Phragmites australis*	LC			+	LC			
R4.02	Coastal reedbeds with *Schoenoplectus* and *Bolboschoenus maritimus*	NT	NT–VU	A1	–	DD	2	WEP 3, OGR 3	WEP 3, OGR 3, CHE 1
R4.03	Coastal reedbeds with *Typha*	LC			+		4		
R5	**Coastal drift lines with organic material**								
R5.01	Drift lines with *Fucus*	EN		CD1	–	VU	2, 3	WEP 3	WEP 3, CC 2, CHE 1, OTF 1, CST 1, IAS 1
R5.02	Drift lines with reed material	LC			+	LC			
R5.03	Drift lines with *Zostera marina*	EN		B1,2a(i,ii)b	–		4	WEP 3, OTF 1	WEP 3, CC 2, CHE 1, OTF 1
R6	**Coastal scrubs and forests**								
R6.01	Coastal scrub with *Hippophaë rhamnoides*	LC			=	LC			WEP 1, OTF 1, CC 1
R6.02	Coastal scrub with *Myrica gale*	VU		A1, A3	–	VU		OGR 3, WEP 2	OGR 3, WEP 2, CC 2
R6.03	Coastal *Salix* thickets	LC			=	LC			
R6.04	Coastal alder stands and scrub	LC			–	LC			CC 1, F 1, CST 1, WT 1, WHC 1
R6.05	Coastal *Juniperus communis* thickets	LC			+	LC			
R6.06	Deciduous-dominated forest stands in outer archipelago	LC			+		4		
R6.07	Coastal alder-dominated moist herb-rich forests	NT		A1, A3, CD1	–	NT		F 2, DR 2, WHC 2, AGCL 2, GP 1, WEP 1, FCWD 1	F 3, DR 2, WHC 2, CST 1, AGCL 1, WEP 1, FCWD 1
R6.08	Coastal mesic deciduous-dominated herb-rich forests	VU		A3, CD1	–	NT[1]	5, 3	F 2, AGCL 2, DR 1, WHC 1	F 2, CST 2, WHC 2, DR 1
R6.09	Coastal dry deciduous-dominated herb-rich forests	VU	VU–EN	B1,2a(i,ii,iii)b, CD1	–	NT[1]	5, 3	F 3, CST 3, OGR 1	CST 3, F 3, OGR 1

[1]In 2008 the habitat type was divided into two assessment units that had the same Red List category.

Code	Habitat type	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
R6.10	Coastal spruce-dominated herb-rich heath forests	EN		A3	–	EN		F 3, AGCL 2, CST 2, DR 2	F 3, DR 1, AGCL 1, CST 1
R6.11	Coastal deciduous-dominated herb-rich heath forests	VU	VU–EN	A1, CD1	–	VU		F 3, CST 3	F 3, CST 3
R6.12	Coastal spruce-dominated mesic heath forests	VU	VU–EN	A1, A3, CD1	=	EN	3, 2	F 3, AGCL 2, CST 1	F 3, CST 1, AGCL 1
R6.13	Coastal birch-dominated mesic heath forests	VU		CD1	–	NT	3, 2	F 3, CST 3, AGCL 1	F 3, CST 3, OGR 1
R6.14	Coastal spruce-dominated dry heath forests	EN		A3, B2a(ii,iii)b	=	EN		F 3, CST 1, ADE 1	F 3, ADE 2, CST 1
R6.15	Coastal pine-dominated dry heath forests	EN		A1	–	CR	3	F 3, CST 2, AGCL 1, ADE 1	F 3, ADE 2, CST 1
R6.16	Coastal birch-dominated dry heath forests	NT		A1	=	NT		F 3, CST 1, ADE 1	F 2, ADE 2, OGR 2
R6.17	Coastal spruce-dominated barren heath forests	EN		B2a(i,ii,iii)b	=	EN		F 3, ADE 1	ADE 2, F 1, CC 1
R6.18	Coastal pine-dominated barren heath forests	VU		A1, A3, CD3	–	VU		F 3, ADE 1	ADE 2, F 1
R6.19	Coastal birch-dominated barren heath forests	NT		A1	–	NT		OGR 3, ADE 2, F 1	OGR 3, ADE 2, F 1
R7	**Coastal rock pools**	NT	LC–NT	CD2a	=	NT		ADE 1, WEP 1	CC 2, ADE 1, WEP 1, CHE 1
R8	**Coastal habitat complexes**								
R8.01	Developmental series of coastal dunes	EN		B2a(i,ii,iii)b, CD1	–	EN		CST 3, WEP 3, F 3, MW 3, EXT 1, ADE 1, IAS 1	WEP 3, MW 3, F 3, IAS 2, CST 2, ADE 1, CC 1
R8.02	Natural forest succession series of the land uplift coast	EN		A1, A3	–	CR	3	F 3, CST 3, DR 2, AGCL 2, ADE 1	F 3, CST 2, CC 1, ADE 1, AGCL 1
R8.03	Barren islands succession series of the land uplift coast	NT		CD2a	–		4	ADE 2, WEP 1, OGR 1, IAS 1	ADE 2, WEP 2, IAS 2, CC 2
R8.04	Islands and islets in outer archipelago	LC			=	LC			CHE 1, WEP 1, IAS 1, CST 1
R8.05	Islets and cliffs with bird colonies	VU		CD1	–	NT	2, 3	IAS 3, OTF 3, ADE 2, WT 1, OGR 1, WEP 1	OTF 3, IAS 3, WT 3, ADE 2, WEP 1, CST 1, CC 1, OGR 1
R8.06	Baltic esker islands	EN	VU–EN	CD1	–	VU	2, 3	CST 3, F 3, WEP 2, EXT 1, MW 1, ADE 1, IAS 1	F 3, CST 3, WEP 3, IAS 2, ADE 1, EXT 1, MW 1

Mechanical wear (MW) is one of the most important reasons for sand beach and dune habitat types becoming threatened. Wear is connected to **construction** (CST), which affects coastal habitat types in many different ways (Figure 4.12). With holiday and permanent residences encroaching on shorelines, uniform coastal areas are becoming fragmented into smaller and smaller sites and their vegetation is changing. Managed garden lawns extend to the waterfront and roads cut through coastal forests. Residences, recreational use and mobility increase mechanical wear and littering. Environments most sensitive to wear include in particular the largest and most extensive sand beach and dune entities that are subjected to significant land use pressure. Although dune and sand beach vegetation is adapted to the natural disturbance dynamics based on sand movement, mechanical wear caused by human activity may result in the destruction of the original vegetation and, at worst, interrupt the entire dune succession process and disrupt the geomorphological structure of dunes. Uncontrolled off-road traffic in particular is destructive to dunes.

In addition to the construction of holiday homes, permanent residences and roads, shores have also undergone many other types of earthworks and **hydraulic construction** (WHC) such as deepening of shores and fairways or construction of landing stages, banks, breakwaters and harbours.

The most significant future threat factors faced by open coastal habitat types (Figure 4.10b) are largely the same as those that have already caused the trend making them threatened. Baltic Sea eutrophication will be a very significant threat in the future, too. Growing volumes of oil and chemicals transport, particularly in the Gulf of Finland, increase the risk of oil spills. The specialised communities of sand beaches are facing a particular risk in coastal habitats. Oil is very difficult and labour-intensive to remove from coastal gravel, shingle and boulder shores. Oil can also destroy entire rock pool communities.

According to the assessment of coastal scrub and forest habitat types, the most important reasons for them becoming threatened are **forest management activities** (F) and **coastal construction** (CST) in its various forms (Figure 4.13a). The shore development inventory conducted by Laurila and Kalliola (2008) depicts the amount and increase of coastal construction. The extent of development on the coast of mainland Finland and on islands exceeding one hectare in size was 48%, while the comparable figure reported by Granö et al. (1999) was 36%. The highest rates of construction can be seen on the shores of coastal towns and cities and their neighbouring municipalities, particularly in the coastal areas of southern and western Finland.

Forestry (F) has affected and is still affecting the development and natural state of primary succession forests in particular. Although forestry has focused most strongly on coniferous and deciduous climax-community stages of succession series, it has also affected younger alder (*Alnus* spp.) forest stages. The

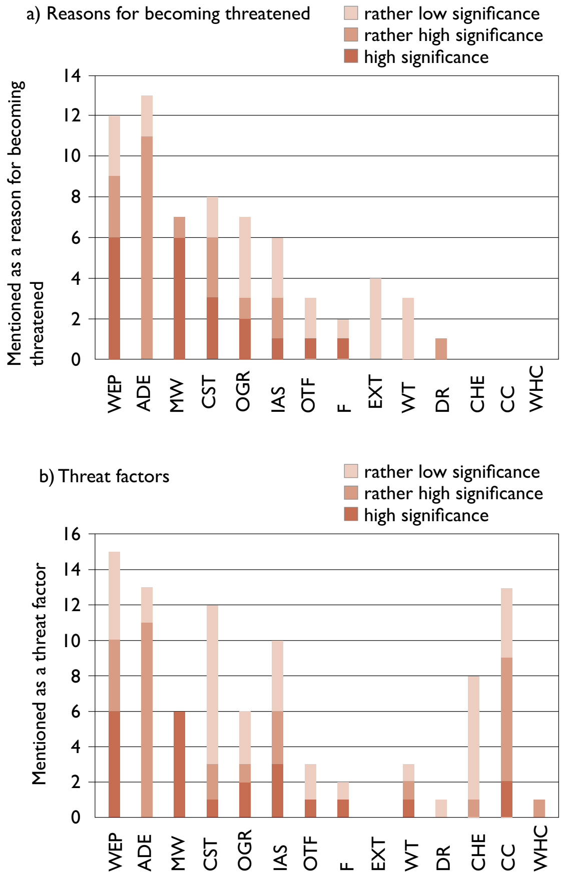


Figure 4.10. Reasons for becoming threatened (a) and threat factors (b) of open coastal habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

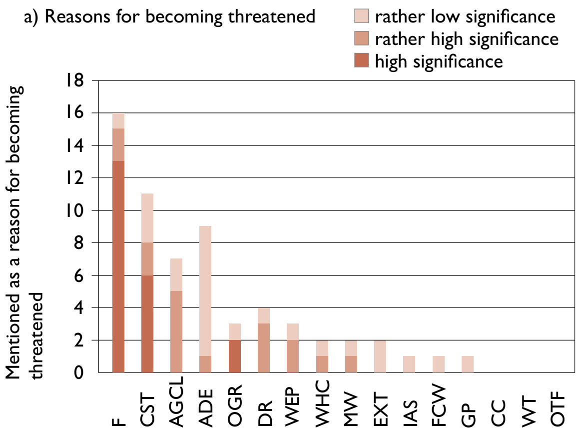
coniferous primary succession forest stages remaining outside protected areas are almost without exception in forestry areas and constricted by residential areas. More herb-rich alder forests are created by land uplift all the time, but once the succession process is interrupted, the development of the subsequent stages is prevented. This is why long, uninterrupted succession series are very rare these days. The impacts of forestry can also be seen in many of the largest esker islands and dune forests. In areas around human residences, extraction of timber for home use and clearing of deadwood from coastal forests have also reduced forest biodiversity.

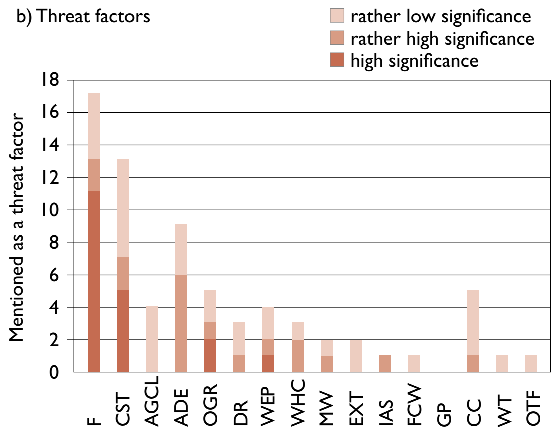
Clearing to establish crop fields and meadows (AGCL) already reduced the area of primary succession forests significantly during the pre-1960s period of traditional agriculture, but the threat posed by clearing for agriculture is no longer regarded as a very significant future threat. **Baltic Sea eutrophication** (WEP) also has an impact on coastal habitat types higher on the shore, and their eutrophication is intensified further by **eutrophying atmospheric deposition** (ADE). The impacts of eutrophication on the most barren and acidic types in particular are considerable. Eutrophying deposition may, among other things, threaten the existence of the most barren types of primary succession forests.

Invasive alien species (IAS) and climate change are growing threats for open as well as forested habitat types. The invasive alien species posing the biggest threat to open shores is the rugosa rose (*Rosa rugosa*), which is capable of growing on very many different types of shore (Figure 4.14). The species is the biggest threat to coastal sand beaches and dunes, where it can spread unobstructed and form uniform stands covering several hectares. The rugosa rose has been found to be still dispersing to new areas (Kunttu et al. 2016). The impacts of **climate change** (CC) are difficult to predict

Figure 4.11. Filamentous algae drifting ashore from the sea cause the overgrowth of coastal sand beaches and meadows. Vanhankylänmaa, Kotka. Photo: Terhi Ryttäri

Figure 4.12. The extensively overgrown and highly constructed sand beach and dune area of Letto, Kalajoki, shown in an aerial photograph from 2005. The white dots show current buildings and the green line the open sand area in accordance with the 1954 basic map. Sources: National Land Survey of Finland 2017, Old printed maps 2017, Population Register Centre 2018.





over the period covered by the assessment, so it was included among the threat factors only in a few cases. Fact box 4.1 takes a closer look at the threat posed by climate change to Baltic Sea coastal habitat types.

4.2.3 Comparison with previous assessment

Six new Baltic Sea coastal habitat types were described and assessed: dunes with deflation surfaces, coastal epilitoral meadows, coastal tall-herb meadows, coastal reedbeds with *Typha*, drift lines with *Zostera marina* and deciduous-dominated forest stands in the outer archipelago. In addition, one new habitat complex was described and assessed: barren islands succession series of the land uplift coast. The habitat types of coastal *Alnus* spp. dominated mesic herb-rich forests and coastal *Betula* spp. and *Prunus padus* dominated mesic herb-rich forests were combined to form a new type, coastal

Figure 4.13. Reasons for becoming threatened (a) and threat factors (b) of coastal scrub and forest habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

Figure 4.14. The alien species rugosa rose (*Rosa rugosa*) takes over sandy as well as gravel, shingle and boulder shores in the archipelago. Motlandet, Porvoo. Photo: Terhi Ryttäri

mesic deciduous-dominated herb-rich forests. The same took place concerning the habitat types of coastal *Alnus* spp. dominated dry herb-rich forests and coastal *Betula* spp. and *Prunus padus* dominated dry herb-rich forests, which were combined to form a new type, coastal dry deciduous-dominated herb-rich forests.

As the method used to assess threat status changed from the national method to IUCN methodology, the results of the first and second assessment are not directly comparable (cf. Mäkinen et al. 2008). In the majority of the assessments, the Red List category assigned was still the same, however (Figure 4.15).

The IUCN Red List category of 11 habitat types or habitat complexes changed. The reason for reclassification was usually a change in method and/or increase in knowledge. Only one reclassification was regarded as reflecting a genuine change in the state of the habitat type: fixed coastal dunes with *Empetrum nigrum* (brown dunes) were uplisted from Vulnerable (VU) to Critically Endangered (CR). The overgrowth of fixed coastal dunes with *Empetrum nigrum* is particularly strong compared with other dune habitat types. Over the past decade, a strong increase in Scots pine (*Pinus sylvestris*) saplings in particular has been observed. There are also no new fixed coastal dunes with *Empetrum nigrum* being created because the amount of moving sand is decreasing due to the overgrowth of deflation surfaces and other surrounding areas and due to reedbed expansion taking place along the shoreline.

National method 2008

IUCN method 2018	LC	NT	VU	EN	CR	DD	NE
LC	9						3
NT		5				1	1
VU		4	6	1			1
EN			2	7	2		1
CR			1				1
DD							

Figure 4.15. Red List categories of Baltic Sea coastal habitat types using IUCN methodology in 2018 and their classification based on the national method in 2008 (45 types). The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassifications. Figures in the NE column refer to new habitat types that were separated only in the second assessment in 2018.

Fact Box 4.1

How will climate change be visible in baltic sea coastal habitats?

Climate change will have many kinds of impacts on the Baltic Sea and its coastal areas and shores. According to the Representative Concentration Pathway (RCP) scenario RCP4.5 commonly used in climate change projections, the mean temperature rise in Finland would be 1.8 °C in the 2020–2049 period relative to 1981–2010. The rise in temperature would be the most pronounced during winters, which is why the projected mean temperature rise for December–February is 2.3 °C. Precipitation would increase by around 5%, with the highest increase to be seen in winter and spring months. (Ruosteenoja et al. 2016)

Increasing winter precipitation facilitates nutrient runoff from drainage basins via rivers to coastal waters and the sea. These impacts can be seen on the shores in the form of increased reedbed expansion and eutrophying filamentous algal masses drifting to the shore and as overgrowth (Figure 4.11). There are currently signs of water quality improving in the eastern part of the Gulf of Finland, but in areas such as the Archipelago Sea and the Bothnian Sea the trend appears to be more negative. There may be differences between the marine areas as regards nutrient leaching and eutrophication or the rate of recovery from this. According to current data, it is more likely that nutrient runoff into the Baltic Sea will increase due to the impact of climate change rather than for it to decrease (Korpinen et al. 2018).

The permanent sea-level rise caused by the melting of continental glaciers will eventually be seen in the Baltic Sea, too. Global sea levels are estimated to rise on average by 26–155 cm by 2100. The rise will not be uniform; it is projected to be in the range of 24–126 cm on the Finnish coast. From 2000 to 2100, the highest sea-level rise is anticipated to be experienced in the Gulf of Finland and the lowest in the Gulf of Bothnia and particularly the Bothnian Bay where land uplift caused by post-glacial rebound compensates for the rise in sea level (Johansson et al. 2014). Over the long term, sea-level rise will have impacts particularly on the habitat types of the low-lying shores of the southern coast of Finland. For example, seashore meadows and coastal meadows may not necessarily be able to translocate further inland when the shoreline moves upwards if the potential new coastal meadow site is composed of a crop field or a developed area (e.g. Finsberg 2014). The slowing or prevention of the land uplift impact has a strong effect on the habitat types of the land uplift coast and on primary succession, the rate of which will slow down or even halt if no new land is exposed from the sea.

The salinity of seawater is projected to decline over the timespan of a hundred years due to reasons such as increased freshwater runoff. This would result in the salinity level of the Bothnian Sea, the Archipelago Sea and the Gulf of Finland corresponding to the current salinity of the Bothnian Bay. Marine species requiring higher salinity levels, such as the common eelgrass (*Zostera marina*) and bladder wrack (*Fucus vesiculosus*) would decline (Jonsson et al. 2018; Vuorinen et al. 2015) and the number and size of drift lines with *Zostera marina* and *Fucus* would decrease and their establishment would even cease. The competitive advantage of salt-tolerant species would weaken on the shores as less saline brackish-water plants also thrive in these areas.

A rise in seawater temperature of almost 1 °C already occurred in the period between 1990 and 2008 (Lehmann et al. 2011) and, by 2100, summer surface water temperatures are projected to rise by 4 °C in the Bothnian Bay and by 2 °C in the Gulf of Finland (Meier et al. 2012). When warmer, the sea freezes more slowly, the period of ice cover is shorter and the ice cover is thinner, and entirely iceless winters become more common. The spring ice melting season and the related strong ice erosion is an important factor maintaining open shores and plays a major role in slowing down and preventing shore overgrowth (Figure 4.16).

There are many factors impacting the overgrowth of open habitat types: mild rainy winters, increasing atmospheric carbon dioxide levels and eutrophying atmospheric nitrogen deposition facilitate, in habitats such as dunes, the growth of mosses and trees and accelerate overgrowth (Provoost et al. 2011). Reduced grazing has an effect in the same direction. Increased growth of tree stands is already visible in habitat types such as fixed coastal dunes with herbaceous vegetation (grey dunes) and fixed coastal dunes with *Empetrum nigrum* (brown dunes).

The strengthening and increased occurrence of extreme weather phenomena also affect coastal habitat types and species. Drought and hot days will become more common. The thinning and earlier melting of snow cover is also projected to increase spring drought periods. In spring 2018, the long dry period coupled with the hot days of May could be seen extensively as drying of vegetation and ponds in the archipelago. On the other hand, coastal salt patches benefit from dry periods as evaporation brings salts to the surface.

Archipelago habitat types are typically very small in area. Therefore their species often occur in a metapopulation structure. The extinction risk of such metapopulations may increase significantly when extreme weather phenomena become stronger. This is because decreases in local variation in weather conditions result in synchrony in fluctuations of local population size (Kahilainen et al. 2018).

Figure 4.16. Spring ice melting and ice sheet movements on the shores are an important coastal phenomenon maintaining openness. Kirkkonummi. Photo: Terhi Ryttäri

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4.3

Inland waters and shores

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Kaukas, Hyvinkää. Photo: Seppo Tuominen

4.3.1

Threat status of inland waters and their shores

Overall results

The overall results of the threat status assessments of inland waters and shores are given in Table 4.3 and Figure 4.17. The number of habitat types distinguished for the assessments was 52 occurring in Southern Finland, 55 in Northern Finland and 59 in the whole country. Most of these belong to lake, stream or shore habitat types. The percentage of inland water habitat types classified as threatened (CR, EN or VU) in Southern Finland is 35% (18 habitat types), in Northern Finland 9% (5 habitat types) and in the whole country 20% (12 habitat types). The threatened habitat types mainly fall in the categories of Vulnerable (VU) or Endangered (EN). The threat status of almost all inland water habitat types in Southern Finland was assessed to be clearly higher than in Northern Finland. The difference between IUCN Red List categories was usually one or two categories. The clearest difference between Southern and Northern Finland is found in spring habitat types, where the difference is as much as three categories.

Stream and river habitat types were assessed as being more threatened than lakes and ponds (Figure 4.18, Table 4.3). Large rivers and rivers in clay-dominated catchment areas were assessed as Critically Endangered (CR) due to regulation and related hydraulic construction in particular. Headwater streams in clay-dominated catchment areas were also classified as CR. The other habitat types occurring exclusively in clay-dominated catchment areas were also assessed as having a rather high threat status: first-order streams in clay-dominated catchment areas were regarded as Vulnerable (VU) and large streams in clay-dominated catchment areas and naturally eutrophic lakes and ponds in Southern Finland as Endangered (EN), which reflects the intensity of land use and the loading caused by it in Southern Finland's clay-dominated areas. Some habitat types were assessed as threatened on the basis of their restricted geographic distribution and their continuing decline. These include calcareous lakes and calcareous ponds and small lakes in Northern Finland.

The highest percentage of habitat types of Least Concern (LC) is found in Northern Finland (45%, 25

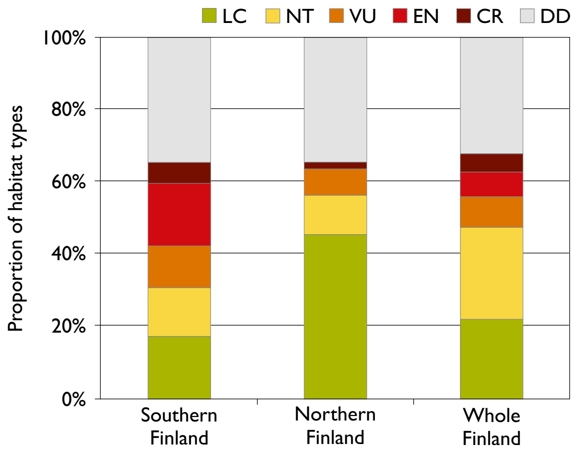

Figure 4.17. Breakdown of inland water and shore habitat types into IUCN Red List categories by percentage of number of habitat types in Southern Finland (52 types), Northern Finland (55 types) and the whole of Finland (59 types).

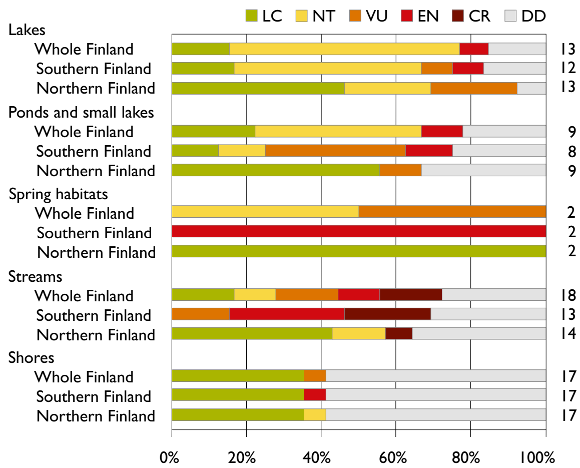

Figure 4.18. Breakdown of inland water and shore habitat types into IUCN Red List Categories in the whole of Finland, Southern Finland and Northern Finland by main group of habitats (percentages of numbers of habitat types). Figures on the right show the numbers of assessed habitat types for each of the main groups in the given region.

habitat types), whereas in Southern Finland the LC percentage is only 17% (9 habitat types) and in the whole country 22% (13 habitat types). The percentage of Near Threatened (NT) habitat types in the whole of Finland is 25% (15 habitat types). The NT percentage in Southern Finland is slightly higher (13%) than in Northern Finland (11%). At the nationwide level, a total of 32% of the habitat types were assessed as Data Deficient (DD), with the percentages for Southern and Northern Finland being almost the same. DD habitat types are the most common among shore habitat types (59%) and stream and river habitat types (28%). Habitat types classified as DD were almost without exception ones that were described and assessed for the first time now. There are no inland water habitat types classified as Collapsed (CO) in Finland.

Threat status of inland waters by habitat type group

At the nationwide level, 62% of Finland's **lake habitat types** were assessed as being Near Threatened (NT) and 8% as being threatened (Figure 4.18). The percentage of threatened lake habitat types in Northern Finland (23%) was slightly higher than in Southern Finland (17%), but those classified as NT are clearly more common in Southern Finland (50%) than in Northern Finland (23%). Naturally eutrophic lakes were classified as Endangered (EN) at the nationwide level and in Southern Finland due to eutrophication. In Northern Finland, large and medium-sized humic lakes have become threatened because of regulation, and both of these habitat types were classified as Vulnerable (VU). Also classified in the VU category in Northern Finland were calcareous lakes because of their restricted occurrence area and continuing decline.

A total of 44% of **pond and small lake habitat types** were classified as Near Threatened (NT) and 11% as threatened at the nationwide level (Figure 4.18). The clearest difference between them and larger lakes was that, among Southern Finland's pond and small lake habitat types, the percentage of threatened habitat types (50%) was clearly higher than that of NT ones (13%). Eutrophic ponds and small lakes have deteriorated due to factors such as agriculture and dredging and were assessed as Endangered (EN) in the whole country and in Southern Finland. Southern Finland's forest ponds and small lakes, mire ponds and small lakes, and calcareous ponds and small lakes were assessed as Vulnerable (VU) due to changes caused by factors including drainage and other forestry measures. In Northern Finland the occurrence area of calcareous ponds is restricted and the above-mentioned factors are causing decline, so they were also classified as VU.

Both of the **spring habitat types** were Endangered (EN) in Southern Finland and Least Concern (LC) in Northern Finland. When assessed as regards the whole of Finland, spring complexes were assessed as Vulnerable (VU) and *Cratoneurion* spring complexes as Near Threatened (NT). The abiotic and biotic quality of spring complexes was assessed as having changed as a result of measures including drainage and other forestry measures as well as groundwater abstraction. *Cratoneurion* spring complexes have become threatened above all due to a reduction in their number. They occur in Southern Finland on nutrient-rich soils, which have been cleared for agricultural land.

When examined at the nationwide level, 11% of **streams and rivers** were assessed as Near Threatened (NT) and 44% as threatened (CR, EN, VU); only streams in the fell area were assessed as Least Concern (LC). Southern Finland's stream and river habitat types were assessed as either threatened (69%) or Data Deficient (DD) (31%), and there were no NT or LC stream habitat types in the subregion. Among Northern Finland's stream and river habitat types, 43% were classified as LC, 14% as NT and 36% as DD. At the nationwide level, the habitat types assessed as Critically Endangered (CR) comprised large rivers and, among the river habitat types in clay-dominated catchment areas, the CR ones were rivers and headwater streams. Large streams in clay-dominated catchment areas and first order streams in clay-dominated catchment areas were assessed as being Endangered (EN). Streams and rivers in clay-dominated catchment areas are located in areas that have been in agricultural use for a long time and are subjected to a lot of nutrient loading. The state of large rivers, on the other hand, has deteriorated significantly due to hydraulic construction. Habitat types classified as Vulnerable (VU) at the nationwide level were rivers and large streams as well as headwater streams in the coniferous forest zone. Their state has also been altered, as regards the largest rivers, by hydraulic construction and, as regards headwater streams, by drainage and clearing.

Of the **shore habitat types** in the whole country as well as in the subregions used in the assessment, just under 60% were classified as Data Deficient (DD) and around a third as Least Concern (LC). Only one shore habitat type – sand and fine sand lake shores – was assessed as threatened throughout the country and in Southern Finland. Regarded as being LC were the open or sparsely vegetated shore habitat types of stone and boulder lake shores and mixed lake and river shores and the vegetated shore habitat types of tall-helophyte beds and lake and river shore scrubs. Classified as DD were the open or sparsely vegetated shore habitat types of stone and boulder river shores, gravel and shingle lake and river shores, erosion banks on lake and river shores, clay and silt lake and river shores, and mud and gyttja lake shores, as well as the vegetated shore habitat type of tall-sedge beds.

Specifically the Data Deficient (DD) shore habitat types may possibly contain declined or altered habitat types that should be classified as threatened but whose assessment requires the collection of further data. The quantity and quality of shores have been reduced particularly by eutrophication and overgrowth. For example, Kolari et al. (2017) and Jantunen et al. (2018) found that open and low-vegetation shores of southern Lake Saimaa had been clearly reduced and shore vegetation had changed compared with the situation in the 1950s (Eurola 1965). The greatest changes had taken

Table 4.3. Results of the threat status assessment of inland water and shore habitat types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V	**Inlandwaters and shores**									
V1	**Lakes**									
V1.01	Small and medium-sized low-humic lakes	F	NT	LC–NT	D1	–	NT		WEP 2, DR 2, CST 1, CHE 1, WHC 1, WBR 1, F 1, ADE 1	WEP 2, DR 2, F 2, CC 2, CST 1, WHC 1, WBR 1, CHE 1, ADE 1, IAS 1
		SF	NT	LC–NT	D1	–	NT			
		NF	LC			–	NT	3, 2		
V1.02	Large low-humic lakes	F	NT	LC–VU	D2b	–	NT		WEP 2, WBR 2, WHC 1, CST 1, CHE 1, DR 1, ADE 1	WEP 2, WBR 2, WHC 1, CHE 1, CST 1, CC 1, ADE 1, IAS 1
		SF	NT	LC–VU	D2b	–	NT			
		NF	NT		B1a(ii,iii)b	–	LC	3, 2		
V1.03	Shallow low-humic lakes	F	NT	LC–VU	D3	–	NT		WEP 2, F 1, DR 1, CST 1, WHC 1, CHE 1, ADE 1	WEP 2, CC 2, DR 1, CST 1, WHC 1, ADE 1, F 1, IAS 1
		SF	NT	NT–VU	D1, D3	–	VU	3, 2		
		NF	LC			–	LC			
V1.04	Small humic lakes	F	NT		D1	=	NT		WEP 2, DR 2, WHC 1, CST 1, CHE 1, F 1	WEP 2, DR 2, WHC 1, CST 1, CC 1, F 1, IAS 1
		SF	NT		D1	=	NT			
		NF	LC			=	LC			
V1.05	Medium-sized humic lakes	F	LC			=	NT	3, 2	WEP 2, DR 1, WHC 1, CST 1, CHE 1, WBR 1, F 1	WEP 2, WBR 2, WHC 1, CST 1, DR 1, CC 1, F 1, IAS 1
		SF	LC			=	NT	3, 2		
		NF	VU		B1a(ii,iii)b, C3, D3	=	LC	3, 2		
V1.06	Large humic lakes	F	NT	LC–NT	D1	=	NT		WEP 2, WBR 2, WHC 1, CST 1, CHE 1	WEP 2, WBR 2, WHC 1, CST 1, CHE 1, CC 1, IAS 1
		SF	NT	LC–VU	D1	=	NT			
		NF	VU	NT–VU	D3	–	NT	3, 2		
V1.07	Shallow humic lakes	F	NT		C2b, D3	–	LC	3, 2	WEP 3, DR 1, CST 1, WHC 1, CHE 1, F 1	WEP 2, DR 1, CST 1, WHC 1, CC 1, IAS 1
		SF	VU		C1, C2b, D1	–	NT	3, 2		
		NF	LC			=	LC			
V1.08	Very humic lakes	F	LC			=	NT	3, 2		WEP 1, DR 1, CST 1, CC 1, IAS 1
		SF	LC			=	NT	3, 2		
		NF	LC			=	LC			
V1.09	Shallow very humic lakes	F	NT		D3, CD3	=	NT		WEP 2, DR 1, F 1, CHE 1, WHC 1, CST 1	WEP 2, DR 1, WHC 1, CST 1, CC 1, F 1, IAS 1
		SF	NT		D3, CD3	=	NT			
		NF	LC			=	NT	3, 2		
V1.10	Subarctic lakes	F	NT		B1a(ii,iii)b	?	LC	3, 2	CC 1, CHE 1, WEP 1	CC 2, CHE 1, WEP 1, IAS 1
		SF								
		NF	NT		B1a(ii,iii)b	?	LC	3, 2		
V1.11	Naturally eutrophic lakes	F	EN	VU–EN	D1	–	EN		WEP 3, WBR 1, WHC 1, CST 1, CHE 1	WEP 3, WBR 2, CC 2, IAS 2, WHC 1, CST 1, CHE 1
		SF	EN		D1	–	EN			
		NF	NT		B1,2a(ii,iii)b	=	NT			
V1.12	Calcareous lakes	F	DD		A1–A3, B1, B2, C1–C3, D1–D3 , CD3	–	VU	5	WEP 2, WHC 1, CST 1, CHE 1	WEP 2, WHC 1, CST 1, CHE 1, IAS 1, CC 1
		SF	DD		A1–A3, B1–B3, C1–C3, D1–D3 , CD3	–	VU	5		
		NF	VU		B2a(ii,iii)b	–	NT	3, 5		
V1.13	Lakes with groundwater influence	F	DD		C1–C3, D1–D3, CD3	–		4		WEP 2, WHC 1, WBR 1, CST 1, GWA 1, CHE 1, DR 1, CC 1, F 1, IAS 1
		SF	DD		C1–C3, D1–D3, CD3	–		4		
		NF	DD		B1, B2, C1–C3, D1–D3, CD3	=		4		

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V2	**Ponds and small lakes**									
V2.01	Esker ponds and small lakes	F	NT	LC–NT	C3	=	NT		CST 2, WEP 1, EXT 1, GWA 1, WHC 1, F 1, DR 1, CHE 1	CST 2, EXT 2, WEP 1, GWA 1, F 1, DR 1, IAS 1
		SF	NT	NT–VU	C3	–	VU	3		
		NF	LC			=	LC			
V2.02	Rocky ponds and small lakes	F	LC			=	LC			WEP 1, CST 1, F 1, CC 1
		SF	LC			=	LC			
		NF	LC			=	LC			
V2.03	Forest ponds and small lakes	F	NT		C3	=	LC	3	WEP 3, F 2, DR 2, CST 2, WHC 1, CHE 1	WEP 2, CST 2, F 2, DR 2, WHC 1
		SF	VU	NT–VU	C3	–	VU			
		NF	LC			=	LC			
V2.04	Mire ponds and small lakes	F	NT	NT–VU	C3	=	LC	3	WEP 3, DR 3, WHC 1, PE 1, F 1	WEP 2, DR 2, WHC 1, PE 1, F 1
		SF	VU	VU–EN	C3	–	NT	3		
		NF	LC			=	LC			
V2.05	Fell ponds and small lakes	F	LC			?	LC			CC 2, CHE 1, WEP 1
		SF								
		NF	LC			?	LC			
V2.06	Naturally eutrophic ponds and small lakes	F	EN	VU–EN	C3	–	CR	3	WEP 3, WHC 3, CST 1, CHE 1, F 1, DR 1	WEP 2, CST 2, WHC 1, F 1, DR 1, CC 1, IAS 1
		SF	EN	VU–EN	C3	–	CR	3		
		NF	DD		B1–B3, C3	=	NT	3		
V2.07	Calcareous ponds and small lakes	F	NT	LC–NT	C3	?	VU	3	WEP 3, WHC 2, CST 1, F 1, DR 1, CHE 1	WEP 2, CST 2, WHC 1, F 1, DR 1, IAS 1
		SF	VU	NT–VU	C3	?	EN	3		
		NF	VU		B2a(ii,iii)b	?	NT	3		
V2.08	Spring ponds and small lakes	F	DD		C3	=	NT	3		CST 2, WEP 1, GWA 1, EXT 1, WHC 1, F 1, DR 1, CC 1, IAS 1
		SF	DD		B2, C3	–	VU	3		
		NF	DD		B1, B2, C3	=	NT	3		
V2.09	Seasonal ponds	F	DD		A1–A3, B2, C3	–		4		DR 2, F 2, GWA 1, CC 1
		SF	DD		A1–A3, B2, C3	–		4		
		NF	DD		A1–A3, B2, C3	=		4		
V3	**Spring habitats**									
V3.01	Spring complexes	F	VU	NT–VU	CD3	=	VU	3	DR 3, F 3, WHC 2, CST 2, GWA 2, AGCL 1, EXT 1	DR 3, F 3, GWA 2, WHC 1, CC 1, CST 1, EXT 1, AGCL 1
		SF	EN	VU–EN	CD3	–	EN			
		NF	LC			=	LC			
V3.02	*Cratoneurion* spring complexes	F	NT	NT–VU	A3	–	VU	3	DR 3, F 3, AGCL 2, WHC 2, GWA 2, CST 1, EXT 1	DR 3, F 3, EXT 2, GWA 2, CC 1, WHC 1, CST 1, AGCL 1
		SF	EN	VU–EN	A3	–	EN			
		NF	LC			=	LC			
V4	**Streams**									
V4.01	Streams in fell area									
V4.01.01	Intermittent streams in fell area	F	LC			?	LC			CC 2, CHE 1
		SF								
		NF	LC			?	LC			
V4.01.02	First order streams in fell area	F	LC			?	LC			CC 2, CHE 1
		SF								
		NF	LC			?	LC			
V4.01.03	Headwater streams in fell area	F	LC			?	LC			CC 2, CHE 1
		SF								
		NF	LC			?	LC			
V4.01.04	Streams and rivers in fell area	F	NT		B1a(ii,iii)b	?	LC	3, 2	CC 1, CHE 1	CC 2, CHE 1
		SF								
		NF	NT		B1a(ii,iii)b	?	LC	3, 2		
V4.01.05	Water falls in fell area	F	DD		B1, B2, C1–C3, D1–D3	?		4		CC 2, CHE 1
		SF								
		NF	DD		B1, B2, C1–C3, D1–D3	?		4		

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V4.02	Streams of coniferous forest zone									
V4.02.01	Intermittent streams in coniferous forest zone	F	DD		A1–A3, C1–C3, D1–D3	–	DD			DR 3, F 2, WEP 1, CST 1, CC 1
		SF	DD		A1–A3, C1–C3, D1–D3	–	DD			
		NF	DD		A1–A3, C1–C3, D1–D3	–	LC	3		
V4.02.02	First order streams in coniferous forest zone	F	NT		C3	–	NT[1]		DR 3, F 2, WEP 2, CST 1, WHC 1, CHE 1	DR 3, F 2, WEP 2, CST 1, WHC 1, EXT 1, CHE 1, CC 1, IAS 1
		SF	VU		C3	–	VU[1]			
		NF	LC			–	LC[1]			
V4.02.03	First order streams in clay-dominated catchment areas	F	EN		C3	–	VU	3	WEP 3, DR 2, F 2, CST 1, CHE 1, WHC 1	WEP 2, DR 2, IAS 2, CST 1, F 1, WHC 1, CHE 1, CC 1
		SF	EN		C3	–	VU	3		
		NF								
V4.02.04	Headwater streams in coniferous forest zone	F	VU		C3	–	NT–VU	3, 5	DR 3, WEP 2, F 2, WHC 1, CST 1, CHE 1	DR 3, F 2, WEP 2, WHC 1, CST 1, EXT 1, CC 1, IAS 1, CHE 1
		SF	EN		C3	–	VU[1]	3, 5		
		NF	NT		C3	–	LC–NT	3, 5		
V4.02.05	Headwater streams in clay-dominated catchment areas	F	CR		C3	–	CR[1]		WEP 3, WHC 2, DR 2, F 2, CST 1, CHE 1	WEP 3, WHC 2, DR 2, CC 2, IAS 2, CST 1, CHE 1, F 1
		SF	CR		C3	–	CR[1]			
		NF								
V4.02.06	Large streams in coniferous forest zone	F	VU	LC–VU	D3	–	NT	3, 2	WHC 2, WEP 2, WBR 2, DR 2, F 1, CST 1, CHE 1	WEP 2, WHC 2, WBR 2, DR 2, F 1, CST 1, EXT 1, CHE 1, CC 1, IAS 1
		SF	VU		D3, CD3	–	VU			
		NF	LC			–	LC			
V4.02.07	Large streams in clay-dominated catchment areas	F	EN		C3	–	CR	3, 2	WEP 3, WHC 2, WBR 2, DR 2, CST 1, CHE 1, F 1	WEP 3, WHC 2, WBR 2, CC 2, IAS 2, DR 1, CST 1, CHE 1, F 1
		SF	EN		C3	–	CR	3, 2		
		NF								
V4.02.08	Rivers in coniferous forest zone	F	VU		C3	–	VU		WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1, CHE 1	WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1, CHE 1, CC 1, IAS 1
		SF	EN		C3	–	EN			
		NF	LC			–	NT	3, 2		
V4.02.09	Rivers in clay-dominated catchment areas	F	CR		C3	–	CR		WEP 3, WHC 3, WBR 2, DR 2, CST 1, CHE 1, F 1	WEP 3, WHC 3, WBR 2, CC 2, IAS 2, DR 1, CST 1, CHE 1, F 1
		SF	CR		C3	–	CR			
		NF								
V4.02.10	Large rivers	F	CR		C3	–	EN	3, 2	WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1	WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1, CC 1, IAS 1
		SF	CR		C3	–	CR			
		NF	CR		C3	–	VU	3, 2		
V4.02.11	Water falls in coniferous forest zone	F	DD		B2, C1–C3, D1–D3	–		4	WHC 3, WEP 2, DR 1	WEP 2, DR 1, CC 1
		SF	DD		B2, C1–C3, D1–D3	–		4		
		NF	DD		B1, B2, C1–C3, D1–D3	=		4		
V4.03	Meandering streams									
V4.03.01	Meandering headwater streams	F	DD		A1–A3, C1, C2a, D1, D2a	–		4		WEP 2, F 2, DR 1, CC 1, WHC 1, CHE 1, IAS 1
		SF	DD		A1–A3, C1, C2a, D1, D2a	–		4		
		NF	DD		A1–A3, C1, C2a, D1, D2a	=		4		
V4.03.02	Meandering streams and rivers	F	DD		A1–A3, C1, C2a, D1, D2a	–		4		WEP 2, DR 1, F 1, CC 1, WHC 1, IAS 1
		SF	DD		A1–A3, C1, C2a, D1, D2a	–		4		
		NF	DD		A1–A3, C1, C2a, D1, D2a	=		4		

[1]In 2008 the habitat type was divided into two assessment units that had the same Red List category.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V5	**Shores**									
V5.01	Stone and boulder lake shores	F	LC			=	LC			R 1, WEP 1, WBR 1, WHC 1, IAS 1
		SF	LC			=	LC			
		NF	LC			=	LC			
V5.02	Gravel and shingle lake shores	F	DD		A1–A3, CD1–CD3	–		4		WEP 2, CST 2, WBR 1, WHC 1, OGR 1, IAS 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD2a	=		4		
V5.03	Sand and fine sand lake shores	F	VU		A1	–	VU		CST 3, WEP 2, WHC 2, WBR 2, MW 1, OGR 1, IAS 1, ADE 1	CST 2, WEP 2, WBR 2, CC 2, WHC 1, MW 1, OGR 1, ADE 1, IAS 1
		SF	EN		A1	–	EN			
		NF	NT	LC–NT	A1	=	NT			
V5.04	Erosion banks on lake shores	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, WHC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.05	Clay and silt lake shores	F	DD		A1–A3, CD1–CD3	–		4		WEP 2, OGR 2, CC 2, CST 1, WBR 1, WHC 1, IAS 1, CHE 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, B1, B2, CD1–CD3	=		4		
V5.06	Mixed lake shores	F	LC			=		4		CST 1, WEP 1, WHC 1, WBR 1, IAS 1
		SF	LC			=		4		
		NF	LC			=		4		
V5.07	Mud and gyttja lake shores	F	DD		A1–A3, CD1–CD3	=		4		CST 1, WBR 1, WHC 1, OGR 1, IAS 1, WEP 1, CC 1
		SF	DD		A1–A3, CD1–CD3	=		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.08	Lake shore scrubs	F	LC			=	LC			CST 1, IAS 1, DR 1, WEP 1, WHC 1, CC 1
		SF	LC			–	LC			
		NF	LC			=	LC			
V5.09	Tall-helophyte beds of lake and river shores	F	LC			=		4		CST 1, WEP 1, WBR 1, WHC 1, IAS 1, CC 1
		SF	LC			=		4		
		NF	LC			=		4		
V5.10	Tall-sedge beds of lake and river shores	F	DD		A1–A3, CD1–CD3	–		4		OGR 3, WEP 2, IAS 2, WHC 1, CST 1, DR 1, WBR 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD2a	=		4		
V5.11	Stone and boulder river shores	F	DD		CD1–CD3	=		4		WBR 2, WEP 1, WHC 1, IAS 1
		SF	DD		CD1–CD3	=		4		
		NF	DD		CD1–CD3	=		4		
V5.12	Gravel and shingle river shores	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, OGR 1, CST 1, WEP 1, WHC 1, IAS 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.13	Sand and fine sand shores and sandbanks of rivers	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, OGR 1, CST 1, WEP 1, WHC 1, MW 1, IAS 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.14	Erosion banks on river shores	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, WHC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.15	Clay and silt river shores	F	DD		A1–A3, CD1–CD3	–		4		WEP 2, CC 2, WBR 1, WHC 1, OGR 1, CST 1, IAS 1, CHE 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.16	Mixed river shores	F	LC			=		4		WEP 1, WBR 1, WHC 1, CST 1, IAS 1
		SF	LC			=		4		
		NF	LC			=		4		
V5.17	River shore scrubs	F	LC			=		4		CST 1, IAS 1, WBR 1, WHC 1, DR 1, CC 1
		SF	LC			=		4		
		NF	LC			=		4		

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

place on fine sand and silt shores as well as clay shores, of which more than half had on the basis of verbal descriptions changed to a high or very high degree. The least amount of changes had taken place on stone and rocky shores (Kolari et al. 2017; Jantunen et al. 2018).

The breakdown of lake habitat types into IUCN Red List categories can also be examined on the basis of the percentages of area covered by them. Of the surface area of Finland's lake water bodies differentiated into types (Water bodies according to the Water Framework Directive 2016), just under 2% represents habitat types that are threatened, around 85% those that are Near Threatened (NT) and around 13% those that are Least Concern (LC). As regards the surface area of the ponds and small lakes examined, less than 1% belong to habitat types assessed as threatened, while around 84% are NT and around 15% LC. The lake as well as pond and small lake data studied covers around 85% of the surface area of Finland's inland waters.

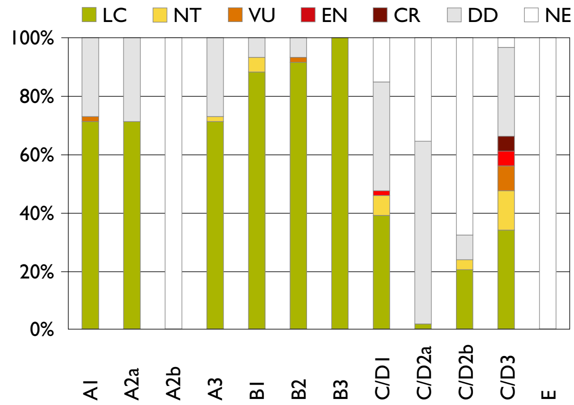

Figure 4.19. Inland water and shore habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria for the whole of Finland (59 types). The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question.

Criterion-specific results and criteria decisive for the final IUCN Red List categories

The criteria most commonly used in the threat status assessments of inland water and shore habitat types were A and B (Figure 4.19), that is, changes in quantity and data regarding geographic distribution. The usage rate of historical, long-term evaluations of criteria concerning changes in quality (C/D3) was almost as high.

When the examination focused exclusively on inland water and shore habitat types that are Near Threatened or threatened (NT–CR) in the whole of Finland, the category was most often determined on the basis of historical quality deterioration having taken place over the long term (C/D3) as the decisive criterion, with this being the case in particular for pond and small lake habitat types and stream and river habitat types. Quality degradation having taken place over the past 50 years (C/D1) was the decisive criterion most commonly used for lake habitat types. There were two habitat types – Cratoneurion spring complexes and sand and fine sand lake shores – that were assessed as Near Threatened (NT) or threatened solely on the basis of a quantitative change (A1 or A3). The IUCN Red List category of two fell area habitat types – subarctic lakes as well as streams and rivers in the fell area – was determined solely on the basis of criterion B, that is, restricted geographic distribution and the continuing decline of the habitat type, being the decisive criterion.

Trends

When examining the whole of the country, 54% of the inland water habitat types were found to show a declining trend and 32% a stable trend, whereas for 14% the trend could not be assessed. In Southern Finland the proportion of habitat types with a declining trend was higher at 73%, while those with a stable trend accounted for 25%. The trend for 2% was not known. In Northern Finland the trend for 65% of the habitat types was assessed as stable and for 20% as declining. The trend for 15% of the habitat types could not be assessed. These were mainly fell habitat types for which the intensity and speed of climate change impacts could not be predicted.

In general, the trend of inland water habitat types was assessed as being more stable in Northern Finland than in Southern Finland. The percentages of stable habitat types were highest in Northern Finland in the habitat type groups of spring complexes and shores. The proportion of those undergoing a declining trend in Southern Finland was greatest in the habitat type groups of spring complexes, ponds and small lakes, streams and rivers and in Northern Finland in lakes and streams and rivers.

Opposite trends were often observed in the quality factors of inland water habitat types. For example, total phosphorus levels may be decreasing while at the same time the water browning phenomenon is reducing abiotic and biotic quality. In such cases, the most significant trend for overall quality was determined through expert assessments.

4.3.2 Reasons for becoming threatened and threat factors

The reasons for inland waters becoming threatened and the threat factors faced by them are shown in Table 4.3 and summarised in Figure 4.20. The most significant reasons for these habitat types becoming threatened are eutrophication and non-toxic pollution of water, hydraulic construction, and drainage. Eutrophication and sediment loading of water bodies are caused by discharges and diffuse source input from agriculture, forestry, peat production, fisheries, residential areas and industry. Sediment loading and organic loading have caused siltation and browning of water bodies. Eutrophication and non-toxic pollution have been of high or rather high significance for 25, hydraulic construction for 12 and drainage for 13 of the total of

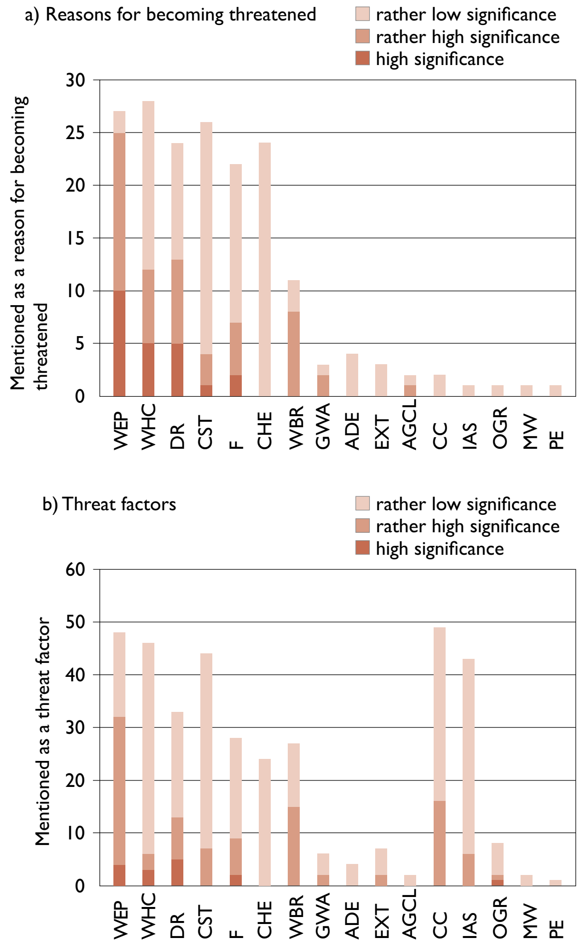

Figure 4.20. Reasons for becoming threatened (a) and threat factors (b) of inland water and shore habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

59 assessed habitat types. Other key reasons for habitat types becoming threatened have included the impacts of forestry (such as logging in the riparian zone and the hydrological impacts of forestry measures carried out in the catchment area), regulation of water bodies and construction on the shoreline. These also apply to the majority of the assessed habitat types.

Clearly the most significant future threat factor is the eutrophication and non-toxic pollution of water bodies, which is of rather high or high significance for 32 habitat types. Hydraulic construction will be a somewhat less significant threat in the future than its role as a reason for inland waters having become threatened. On the other hand, regulation was assessed as posing a rather high threat to 14 habitat types. Drainage was regarded as constituting at least a rather high threat in the future to 13 habitat types. Significant future threats are also caused by forestry and construction on the shoreline. Climate change and invasive alien species were regarded as new growing threats. Climate change was assessed as being a future threat for 49 habitat types, with the significance of the threat being rather high for 16 of these. Alien species were assessed as posing a rather high threat for 6 habitat types and a lower one for 37 habitat types. The overgrowth of open areas following the discontinuation of mowing and grazing is a future threat concerning shore habitat types. It has, however, affected shore habitat types already for several decades. Nevertheless, this is not reflected in the reasons for shore habitat types becoming threatened as the majority of them are classified as Least Concern (LC) or Data Deficient (DD), with no reasons usually listed for these categories.

The eutrophication and non-toxic pollution of water bodies was assessed as the most significant reason for **lake and pond habitat types** becoming threatened. The state of headwater lakes and ponds is degraded particularly by loading caused by forestry measures (final felling, mechanical soil manipulation, drainage for forestry, and fertilisation). Loading from agriculture is the highest in Southern and Western Finland and also in Ostrobothnia, Ylä-Savo and parts of North Karelia (Mäenpää and Tolonen 2011). Loading of nutrients and organic matter from urban areas and industry has been reduced clearly in areas such as various parts of Lakes Saimaa, Päijänne, Kallavesi, and Pyhäjärvi, Tampere. In addition to nutrient loading, sediment and organic loading from human activity also ends up in lakes. Adverse effects of organic loading and sediment loading include shallowing of lakes and ponds, benthic siltation, darkening and increased turbidity of water as well as oxygen problems (Vuori and Korjonen-Kuusipuro 2018).

The natural state of lakes has also been degraded significantly by water level regulation and lowering as well as by hydraulic construction and construction on the shoreline. A significant proportion of large and medium-sized lakes are regulated. Regulation alters natural water level fluctuation by increasing the lowering of water level in the winter and by reducing spring floods. These changes have an adverse effect on the organisms of the littoral and riparian zones in particular. In shallow lakes, regulation also impairs water quality. Absence of spring floods may result in overgrowth of shallow bays if the lake is subjected to nutrient loading (Mäenpää and Tolonen 2011).

The most significant factors that have affected **stream and river habitat types** include land use in catchment areas and the resulting alternation of the natural hydrological state (such as the flood cycle), diffuse and point source input as well as clearing, damming and regulation of water bodies. River construction and regulation have significantly reduced the surface area of rapids and degraded the quality of rapid habitats (Figure 4.21). Particularly in rivers, the alteration of slack water and rapids has been replaced due to hydraulic construction by chains of reservoirs whose biotic communities have changed in comparison with the original ones. Short-term regulation creates constantly changing conditions as regards water depth and flow rate, which also causes changes in zoobenthic

Figure 4.21. Hydraulic construction and regulation of water bodies are significant reasons for stream and river habitat types becoming threatened and will also affect their state in the future. River Oulujoki, Merikoski rapids. Photo: Kari-Matti Vuori

communities (Mäenpää and Tolonen 2011). The majority of large rivers are cut by hydroelectric dams and heavily regulated, and damming also affects a significant proportion of smaller rivers. Damming prevents the upstream access of migratory fish, which also affects the fish stocks of unregulated rivers and streams further upstream.

The factor assessed as having the most significant impact causing changes in streams and rivers is diffuse source input from agriculture and forestry in particular, but there is an impact also more locally from peat production, residential areas and industry, which causes eutrophication and siltation. Of these, loading from agriculture is the heaviest in Southern and Western Finland and affects streams in clay-dominated catchment areas characteristic of clay soils especially. The proportion of cultivated fields in the catchment area has a significant impact on total phosphorus, total nitrogen and solids contents of river and large stream water in particular. Increases in nutrient levels in streams and rivers in turn have the greatest impact on periphyton, hydrophytes and other primary producers (Aroviita et al. 2014). The impacts of forestry and related drainage on stream and river water quality can be seen particularly as the darkening of water and increases in organic nitrogen levels. The state of hydrophytes and periphyton has been observed to have declined particularly in rivers and streams downstream from intensive forestry and from catchment areas with a high degree of drainage (Rääpysjärvi et al. 2016). Nutrient loading of previously drained peatland areas may still increase despite dozens of years having passed since the ditches were dug (Nieminen et al. 2017). Suspended solid material leaching off from ditches may be transported by flowing water to river and stream bottoms, reducing their species diversity (Turunen et al. 2016; Aroviita et al. 2016). Municipal and industrial nutrient loading has decreased since the late 1980s. As regards nitrogen, however, municipal discharges are still high.

In addition to nutrient and sediment loading, ditch drainage in catchment areas and straightening and clearing of channels have caused structural and hydrological changes in stream and river habitats. Ditch drainage was regarded in this assessment as the strongest factor causing small streams in the coniferous zone to become threatened, but its significance was also regarded as rather high for most river and large stream habitat types. Changes targeted at the structure of the channel, such as straightening and stone removal, have effects including reduced variety in flow types. Drainage results in reduced water retention in the catchment area, which causes more extreme flooding (Aroviita et al. 2016). As regards small streams in particular, in addition to drainage, a significant reason for these habitat types becoming threatened and a factor posing a future threat to them consists of other forestry measures, such as felling and mechanical soil manipulation, which cause not only loading but also hydrological changes as well as structural changes in adjacent areas.

The most significant factors assessed as having altered **spring complexes** were drainage and other measures of forestry. Extensive drainage of mires and forests has degraded the state of spring complexes and eradicated their occurrences. Small springs have also been lost in conjunction with mechanical timber harvesting. Springs have been included in the Forest Act since 1997 as habitats of special importance, but delimitation decisions in accordance with the Act have been found to cover only part of the sites meeting the criteria (Kotiaho and Selonen 2006; Pykälä 2007; Juutinen and Kotiaho 2009). In addition, clearing for agricultural purposes and groundwater abstraction as well as the

Figure 4.22. Large helophytes such as the common reed (*Phragmites australis*), as well as trees and shrubs are taking over previously open and low-vegetation shores. Photo: Kimmo Syrjänen

introduction of related structures have degraded the state of springs. Changes in groundwater quality also change the quality of springs. Measurement data on springs studied by Lehosmaa et al. (2018) whose water quality had deteriorated show nitrate concentrations on average up to 30 times higher and major changes in their species composition compared to natural springs. The observed biological degradation is likely to be also connected with the increase in the concentrations of other substances such as pesticides and metals (Lehosmaa et al. 2018).

Adverse chemical effects apply to a number of inland water habitat types, but their significance is assessed as quite low on the nationwide scale. Substances and compounds specified in the Government Decree on Substances Dangerous and Harmful to the Aquatic Environment (1022/2006; 868/2010) include various heavy metals and toxic organic compounds. Dangerous and harmful substances enter water bodies from sources including municipal, mining and industrial wastewater, landfill sites, transport, through long-range airborne transport and as a result of land use (Mäenpää and Tolonen 2011). In predominantly agricultural areas, substances such as herbicides also end up in water bodies.

In acid sulphate soils of the drained land areas of Western Finland, sulphuric acid formed in the soil and the resulting acidity of runoff water causes significant problems. Acidic runoff water dissolves considerable amounts of metals and many heavy metals from the soil. Acidity peaks occurring in water bodies may cause extensive fish deaths and even the total disappearance of fish from streams (Sutela et al. 2012). Research into concentrations of, for example, pharmaceutical substances and microplastics in water bodies has only commenced in recent years in Finland. The combination effects of chemicals are not yet sufficiently known, either. Although the concentrations of individual compounds may be harmless, their combination effect may still have adverse effects on organisms.

Because the majority of **shore habitat types** were classified as Least Concern (LC) or Data Deficient (DD), the reasons for habitat types becoming threatened in this context only apply to sand and fine sand lake shores, which were assessed as being threatened. The most significant reasons for their threat status were construction on the shoreline, eutrophication and siltation of water bodies and shores, hydraulic construction and regulation. The significance of construction on the shoreline and hydraulic construction is assessed as being somewhat lower as a future threat than as a reason for habitat types having become threatened. The reasons making sand shores threatened have also caused the decline of the natural state of many other shore habitat types and will continue to do so in the future, too.

Shores are affected by an overgrowth process accelerated by several different factors. Common since the 1950s, the eutrophication of water bodies and shores, discontinuation of grazing and mowing and, in places, also hydraulic construction and regulation of water bodies have facilitated the succession and overgrowth of open and low-vegetation shores. The common reed (*Phragmites australis*) and other large helophytes have encroached on open and sparsely vegetated shores and sedge beds, and there has been an increase in scrubs and tree stands (Figure 4.22). The rate of overgrowth is rapid, particularly if the shore used to be grazed or mowed or water level fluctuation has decreased. Overgrowth does, however, also take place on shores not having previously been grazed or mowed. This is due to the general eutrophication trend seen also in terrestrial environments. This trend could not be fully illustrated using the available threat codes. Climate change is projected to accelerate this trend. Overgrowth has in recent decades been observed in areas including southern Lake Saimaa (Kolari et al. 2017; Jantunen et al. 2018) where the species composition of shores has become less diverse. Shrubs and trees as well as large species indicating eutrophy, such as the common reed (*Phragmites australis*), cowbane (*Cicuta virosa*), bulrush (*Typha latifolia*) and yellow iris (*Iris pseudacorus*), have increased. At the same time, overgrowth has crowded out sedges and grasses, and many species of low-growing meadows and pastures have become rarer.

Climate change was regarded as a growing future threat for inland water and shore habitat types. Its impacts were assessed to be the strongest on the fell area, on habitat types with their occurrence area focusing on southwestern Finland (streams, rivers and shores in clay-dominated areas, naturally eutrophic lakes) as well as on oligotrophic and clear-water (low-humic) lakes that are sensitive to increased humus contents. The temperatures of water bodies have risen over the past decades, and the period with ice cover has shortened. At the same time, climate change affects hydrological conditions, changing the seasonal distribution of runoff, flow rates and water levels. Winter runoff is increasing, winter floods are becoming more common and, correspondingly, spring floods are decreasing. Changes in runoff also result in changes in nutrient leaching and sediment transport (e.g. Huttunen et al. 2015). On the basis of modelling studies, distribution ranges of species such as hydrophytes and zoobenthic species have been estimated to extend towards the north due to climate change (Alahuhta et al. 2011; Mustonen et al. 2018).

The threat posed by invasive alien species is highest for mesotrophic and eutrophic inland water habitat types. Of species classified as invasive alien species in Finland (Niemivuo-Lahti 2012), those including the reed sweetgrass (*Glyceria maxima*), hedge bindweed (*Calystegia sepium*) and Himalayan balsam (*Impatiens glandulifera*) easily spread among riparian vegetation. Invasions of alien species are common in Central Europe, for example, and the risk of their increased abundance is amplified by climate change. In Finland, the abundance of alien species can be expected to increase at least locally, mainly in Southern Finland. In a study of the shores of southern Lake Saimaa (Kolari et al. 2017; Jantunen et al. 2018), invasive alien species observed on the shores comprised the Himalayan balsam, hedge bindweed, reed sweetgrass and large-leaved lupine (*Lupinus polyphyllus*). Five species have been classified in Finland's National Strategy on Invasive Alien Species as invasive alien species in inland waters: the brook trout (*Salvelinus fontinalis*), signal crayfish (*Pacifastacus leniusculus*), reed sweetgrass (*Glyceria maxima*), Canadian waterweed (*Elodea canadensis*) and crayfish plague (*Aphanomyces astaci* (As, Ps1)). Water bodies such as the calcareous lakes of the Koillismaa region are susceptible to the spread and mass invasions of Canadian waterweed. Even in very recent years, new alien species such as the fringed water lily (*Nymphoides peltata*) and the magnificent bryozoan (*Pectinella magnifica*) have spread into Finland's inland waters. In addition, potential new alien species which may spread into Finland and cause adverse effects can be found in Finland's neighbouring areas. These include the Nuttall's waterweed (*Elodea nuttallii*).

4.3.3

Comparison with previous assessment

The results of the 2008 and 2018 assessments are not directly comparable with each other as the assessment method has changed from Finland's national method to IUCN methodology (cf. Ilmonen et al. 2008). Figure 4.23 illustrates the number of changes of threat status category made since the previous assessment as a result of the new assessment. Altogether 8 habitat types were uplisted and 6 were downlisted. The Data Deficient (DD) category was assigned for 2 habitat types, one previously assessed as Near Threatened (NT) and the other as Vulnerable (VU). The number of new habitat types included in the assessment totalled 20.

In most cases the reason for a reclassification was a change in method. In many cases an increase in knowledge also played a role as this assessment had access to data including variables and results of the classification of the ecological status of Finnish surface waters, which were not yet available for the previous assessment. Not a single IUCN Red List category change of a habitat type was attributable to a genuine change. This means that any downlisting to a lower category must not be interpreted as indicating that the habitat type's state has improved and that any uplisting does not indicate an increased risk of collapse since the previous assessment.

IUCN method 2018 \ National method 2008	LC	NT	VU	EN	CR	DD	Multiple in 2008	NE
LC	7	2						4
NT	5	8	2					
VU		1	3				1	
EN			1	1	2			
CR				1	2			
DD		1	1			1		16

Figure 4.23. Red List categories of inland water and shore habitat types for the whole of Finland using IUCN methodology in 2018 and their classification based on the national method in 2008 (59 types). The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassifications. The column "Multiple in 2008" gives the number of those assessments where the habitat type classification has changed and where there were multiple habitat types assigned to different categories by the national method in 2008 corresponding to a single habitat type assessed with IUCN methodology in 2018. Figures in the NE column refer to new habitat types that were separated only in the second assessment in 2018.

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4.4

Mires

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Siikaneva, Ruovesi. Photo: Hannu Nousiainen

4.4.1
Different levels of assessment

The threat status of mire habitats was assessed at the habitat complex level (mire complexes and mire succession series of the land uplift coast) and at the habitat type level (mire type groups, mire types and low-productive seasonal wetlands). However, examining the state of mire habitats also requires examination at the level of more extensive mire entities – or mire systems – and at the level of various landscape types covering entire catchment areas. The state of a mire depends on the intactness of its hydrology, which may be affected by many types of human activity in the mire itself or in its catchment area. For example, even if carried out further away, drainage, hydraulic construction, forestry, road construction or groundwater abstraction may be reflected in the quality and quantity of water input into the mire and may, for example, prevent natural spring floods from reaching the mire. Living conditions of mire species also deteriorate due to fragmentation of mire areas and reduced connectivity caused by human land use.

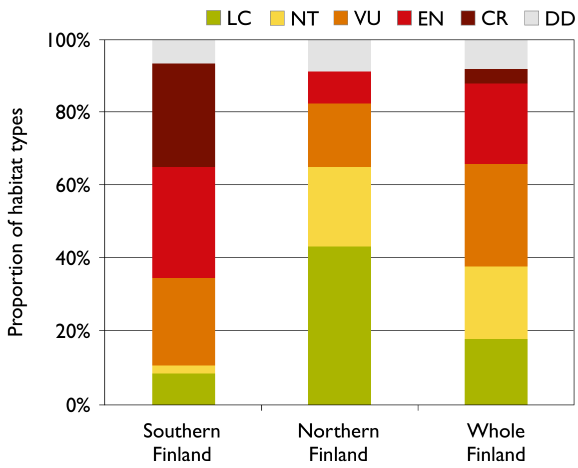

Figure 4.24. Breakdown of mire habitat types into IUCN Red List categories by percentage of number of habitat types at the lowest hierarchical level in Southern Finland (46 types), Northern Finland (46 types) and the whole of Finland (50 types).

4.4.2
Threat status of mire habitat types

The occurrence of threatened mire types focuses on the hemiboreal, south boreal and middle boreal zones – that is, the Southern Finland subregion used in the assessment (Table 4.4, Figure 4.24). Rich fens, spruce mires as well as spruce-birch fens and rich spruce-birch fens are the most threatened habitat type groups. The percentages provided below take into account the habitat types in accordance with the lowest assessed hierarchical level.

Whole country

At the level of the whole of Finland, of the 50 assessed mire habitat types (the lowest assessed hierarchical level) 27 habitat types or 54% were assessed as being threatened (VU, EN or CR). A total of 20% of the assessed mire habitat types were classified as Near Threatened (NT), 18% as Least Concern (LC) and 8% as Data Deficient (DD) (Figure 4.24). Of the threatened habitat types, 2 types (4% of the assessed habitat types) were classified as Critically Endangered (CR), 11 (22%) as Endangered (EN) and 14 (28%) as Vulnerable (VU). The CR mire habitat types are rich birch lawn fens and calcareous fens. Classified as Endangered (EN) are the spruce mire habitat types of thin-peated spruce mires and dwarf-shrub spruce mires including their sub-types; the spruce-birch fen habitat type of *Carex nigra* birch fens; the pine mire and bog habitat types of spruce-pine mires and palsa bogs; the rich fen habitat types of rich birch flark fens and rich birch lawn fens; and the wooded swamp habitat types of black alder (*Alnus glutinosa*) and grey alder (*A. incana*) swamps. There are no habitat types assessed as Least Concern (LC) in the groups of spruce mires, spruce-birch fens and rich spruce-birch fens or rich fens (Figure 4.25, Table 4.4). In other groups, habitat types classified as LC comprise open swamps and some shrub swamp types as well as some ombro- or oligotrophic pine bog, pine fen and fen types whose natural occurrence focuses on Northern Finland. A total of 4 habitat types (pounikkos, rich swamp fens, birch swamps and low-productive seasonal wetlands) were classified as Data Deficient (DD).

Mires

Table 4.4. Results of the threat status assessment of mire habitat types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change (marked with * if the change is related to the shift in assessment time frame), 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
S	**Mires**									
S01	**Spruce mires**									
S01.01	Thin-peated spruce mires	F	EN		A1, A3	–	VU	3, 1	DR 3, F 3, AGCL 2, CST 1, WHC 1	F 3, DR 2, CST 1, WHC 1, AGCL 1
		SF	CR		A3	–	VU	3, 1		
		NF	VU		A1, A3	–	LC	3, 1		
S01.02	Thin-peated rich spruce mires	F	VU	VU–EN	A1, A3	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1	DR 2, F 2, CST 1, WHC 1, AGCL 1
		SF	EN	EN–CR	A1, A3	–	EN			
		NF	VU		A1	–	NT	3		
S01.03	Herb-rich spruce mires	F	VU	VU–EN	A3	–	VU		DR 3, AGCL 3, F 2, WHC 2, CST 1, PE 1	DR 2, F 2, CST 1, WHC 1, PE 1, AGCL 1, IAS 1
		SF	EN	EN–CR	A3	–	EN			
		NF	NT		A1, A3	–	NT			
S01.04	Dwarf-shrub spruce mires	F	EN		A1, A3	–	VU	3, 1	DR 3, F 3, AGCL 1, WHC 1, CST 1, PE 1	F 3, DR 2, CST 1, WHC 1, PE 1, AGCL 1
		SF	EN		A1, A3	–	VU	3, 1		
		NF	VU		A1	–	NT	3, 1		
S01.04.01	*Vaccinium* spruce mires	F	EN		A1, A3	–	VU[1]	3, 1	DR 3, F 3, AGCL 1, WHC 1, CST 1	F 3, DR 2, CST 1, WHC 1, AGCL 1
		SF	EN		A1, A3	–	VU[1]	3, 1		
		NF	VU		A1	–	NT[1]	3, 1		
S01.04.02	*Equisetum sylvaticum* spruce mires	F	EN		A1, A3	–	EN		DR 3, F 3, AGCL 1, WHC 1, CST 1	F 3, DR 2, CST 1, WHC 1, AGCL 1
		SF	EN		A1, A3	–	EN			
		NF	VU		A1	–	VU			
S01.04.03	*Rubus chamaemorus* spruce mires	F	EN		A1, A3	–	VU	3	DR 3, F 3, AGCL 1, WHC 1, CST 1, PE 1	F 3, DR 2, CST 1, WHC 1, PE 1, AGCL 1
		SF	EN		A1, A3	–	VU	3		
		NF	NT		A1, A3	–	NT			
S02	**Spruce-birch fens and rich spruce-birch fens**									
S02.01	Rich spruce-birch fens	F	VU	VU–EN	A1, A3	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1, OGR 1	DR 3, F 2, OGR 1, CST 1, WHC 1, EXT 1, GWA 1
		SF	CR		A3	–	CR			
		NF	VU		A1, A3	?	VU			
S02.02	Tall-sedge spruce-birch fens	F	VU		A1, A3	–	NT	3	DR 3, F 2, AGCL 2, WHC 1, CST 1, PE 1	DR 2, F 1, WHC 1, PE 1, AGCL 1
		SF	EN		A1, A3	–	VU	3		
		NF	NT		A1	=	NT			
S02.03	*Carex nigra* birch fens	F	EN		A1, A3	–	EN		DR 3, F 2, AGCL 1, CST 1	DR 2, F 1, WHC 1
		SF	EN		A1, A3	–	EN			
		NF								
S02.04	*Eriophorum vaginatum* birch fen	F	VU	NT–VU	A1, A3	–	EN	2, 1*	DR 3, F 2, AGCL 1, PE 1, CST 1	DR 2, F 1, WHC 1, PE 1, AGCL 1
		SF	VU	VU–EN	A1, A3	–	EN	2, 1*		
		NF	LC	LC–NT		=	NT	3		
S03	**Pine mires and bogs**									
S03.01	Thin-peated pine mires	F	VU	VU–EN	A1, A3	–	NT	3, 1	DR 3, F 3, AGCL 1, CST 1	F 3, DR 2, CST 1, AGCL 1
		SF	EN		A1, A3	–	NT	3, 1		
		NF	NT		A1, A3	–	LC	3, 1		
S03.02	Spruce-pine mires	F	EN		A1	–	VU	3	DR 3, F 2, AGCL 1, CST 1	F 2, DR 2, AGCL 1
		SF	EN		A1, A3	–	VU	3		
		NF	NT		A1, A3	=	NT			
S03.03	*Carex* globularis pine mires	F	NT		A1, A3	–	NT		DR 3, F 2, AGCL 1, CST 1	DR 2, F 1, AGCL 1
		SF	VU		A1, A3	–	VU			
		NF	LC			=	LC			
S03.04	Dwarf-shrub pine bogs and mires	F	NT	NT–VU	A1, A3	=	LC	3	DR 3, F 2, PE 2, CST 1	F 2, DR 1, PE 1
		SF	VU	VU–EN	A1, A3	=	NT	3		
		NF	LC			=	LC			
S03.05	*Eriophorum vaginatum* pine bogs and mires	F	NT	NT–VU	A1, A3	=	LC	3	DR 3, F 2, PE 2, CST 1, AGCL 1	PE 2, DR 1, F 1, AGCL 1, OTF 1
		SF	VU	VU–EN	A1, A3	=	NT	3		
		NF	LC			=	LC			
S03.06	*Sphagnum fuscum* bogs	F	LC			=	LC			PE 1, OTF 1
		SF	LC			=	LC			
		NF	LC			=	LC			

[1]In 2008 the habitat type was divided into two assessment units that had the same Red List category.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
S03.07	Frost bogs and mires	F	DD		A1–A3, CD1–CD3	–	NT	3		CC 3, GP 1
		SF								
		NF	DD		A1–A3, CD1–CD3	–	NT	3		
S03.07.01	Palsa bogs	F	EN	EN–CR	A2a, E	–		4	CC 2, GP 1	CC 3, GP 1
		SF								
		NF	EN	EN–CR	A2a, E	–		4		
S03.07.02	Pounikkos	F	DD		A1–A3, CD1–CD3	–		4		CC 3, GP 1
		SF								
		NF	DD		A1–A3, CD1–CD3	–		4		
S04	**Pine fens and rich pine fens**									
S04.01	Rich pine fens	F	VU		A1, A3	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1, OGR 1	DR 3, OGR 2, F 1, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1
		SF	CR		A3	–	CR			
		NF	VU		A1	–	VU			
S04.01.01	Mire margin influenced rich pine fens	F	VU		A1, A3	–		4	DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1, OGR 1	DR 3, OGR 2, F 1, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1
		SF	CR		A3	–		4		
		NF	VU		A1	–		4		
S04.01.02	Rich pine fens with *Sphagnum fuscum*	F	NT		A1, A3	–		4	DR 3, AGCL 2, F 2, WHC 1, CST 1, GWA 1	DR 3, F 1, OGR 1, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1
		SF	CR		A3	–		4		
		NF	NT		A1	–		4		
S04.02	Moderately rich pine fens	F	VU	NT–VU	A1	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1	DR 3, F 1, CST 1, WHC 1, GWA 1, AGCL 1, PE 1
		SF	CR		A3	–	CR			
		NF	NT		A1	=	VU	3		
S04.03	Tall-sedge pine fens	F	VU	NT–VU	A3	–	LC	3	DR 3, F 2, AGCL 2, PE 2, CST 1	DR 2, F 1, PE 1, AGCL 1
		SF	EN		A3	–	VU	3		
		NF	LC			=	LC			
S04.04	*Sphagnum papillosum* pine fens	F	NT	NT–VU	A1, A3	=	VU	5	DR 3, PE 2, F 1, AGCL 1, CST 1	DR 1, F 1, PE 1, AGCL 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	NT	5		
S04.05	Flark pine fens	F	LC	LC–NT		–	LC		DR 3, PE 1, F 1, AGCL 1, WHC 1, CST 1	DR 2, PE 1, WHC 1, CC 1
		SF	EN	VU–EN	C1	–	NT	3, 2, 1		
		NF	LC			=	LC			
S04.06	Low-sedge pine fens	F	NT		A1, A3	=	NT		DR 3, F 1, AGCL 1, PE 1, CST 1	DR 1, F 1, PE 1, AGCL 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	NT	3, 1*		
S04.07	Ridge-hollow pine bogs	F	LC	LC–NT		=	LC		DR 2, PE 2, AGCL 1, CST 1, ADE 1	PE 1, ADE 1
		SF	NT		A1	–	LC	3		
		NF	LC			=	LC			
S05	**Fens**									
S05.01	Moderately rich fens	F	VU		A1, A3	–	VU		DR 3, AGCL 3, PE 1, CST 1, WHC 1, GWA 1	DR 3, OGR 2, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1, PE 1
		SF	CR		A3	–	CR			
		NF	NT	NT–VU	A1, A3	=	NT			
S05.02	Swamp fens	F	NT		A1, A3	–	LC	3	DR 3, WHC 2, WBR 2, AGCL 2, CST 1, OGR 1	DR 2, WBR 2, WHC 1, CST 1, OGR 1
		SF	VU		A3	–	NT	3		
		NF	LC			=	LC			
S05.03	Tall-sedge fens	F	NT	NT–VU	A1, A3	–	LC	3	DR 3, AGCL 3, PE 2, CST 1, WHC 1	DR 2, PE 1, CST 1
		SF	VU		A1, A3	–	VU			
		NF	LC			=	LC			
S05.04	*Sphagnum papillosum* low-sedge fens	F	NT	NT–VU	A1, A3	=	NT		DR 3, PE 2, AGCL 1, CST 1	DR 1, PE 1, CST 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	LC			
S05.05	Flark fens	F	LC			–	LC		DR 3, AGCL 1, WHC 1, PE 1, CST 1	DR 2, PE 1, CST 1, CC 1
		SF	EN	VU–EN	C1	–	NT	3, 1		
		NF	LC			=	LC			
S05.06	Minerotrophic low-sedge fens	F	NT		A1, A3	=	LC	3	DR 3, AGCL 1, PE 1, CST 1	DR 1, PE 1, CST 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	LC			
S05.07	Hollow bogs	F	LC			=	LC			PE 1, ADE 1
		SF	LC			–	NT	3		
		NF	LC			=	LC			
S05.08	Ombrotrophic low-sedge bogs	F	LC	LC–NT		=	LC			DR 1, PE 1, ADE 1, OTF 1
		SF	LC	LC–NT		=	NT	1*		
		NF	LC			=	LC			

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
S06	**Rich fens**									
S06.01	Rich swamp fens	F	DD		A1–A3, CD1–CD3	–	EN	3	DR 3, AGCL 3, CST 2, WHC 2, WBR 2, OGR 1	DR 2, OGR 2, CST 1, WHC 1, WBR 1, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	DD		A1–A3, B1, B2, CD1–CD3	=	EN	3		
S06.02	Rich spring fens	F	VU		A1	–	VU		DR 3, F 3, GWA 2, AGCL 1, CST 1, EXT 1	GWA 3, DR 2, F 1, CST 1, EXT 1
		SF	CR		A3	–	CR			
		NF	NT		A1	=	NT			
S06.03	Rich birch fens	F	EN	EN–CR	A3	–	VU	3	AGCL 3, DR 3, WHC 1, PE 1, GWA 1, CST 1, F 1, EXT 1, OGR 1	DR 3, GWA 2, EXT 2, CST 1, OGR 1, WHC 1, AGCL 1, CC 1
		SF	CR		A3	–	CR			
		NF	VU		A1, A3	–	NT	3		
S06.03.01	Rich birch flark fens	F	EN		A3	–	VU	3	DR 3, AGCL 2, WHC 1, PE 1, GWA 1, EXT 1, CST 1	DR 3, EXT 2, GWA 1, CST 1, WHC 1, AGCL 1, CC 1
		SF	CR		A3	–	CR			
		NF	VU		A1, A3	–	NT	3		
S06.03.02	Rich birch lawn fens	F	CR		A3	–	CR		AGCL 3, DR 3, WHC 1, PE 1, GWA 1, CST 1, F 1, EXT 1, OGR 1	DR 3, GWA 2, EXT 2, OGR 1, CST 1, WHC 1, AGCL 1
		SF	CR		A3	–	CR			
		NF	EN		A1, A3	–	EN			
S06.04	Rich lawn fens	F	EN	EN–CR	A1, A3	–	EN		AGCL 3, DR 3, OGR 2, WHC 1, PE 1, CST 1, GWA 1, EXT 1	DR 3, OGR 2, GWA 2, EXT 1, WHC 1, CST 1
		SF	CR		A3	–	CR			
		NF	EN		A1, A3	–	EN			
S06.05	Rich flark fens	F	VU		A1, A3	–	NT	3, 1	DR 3, AGCL 2, WHC 1, PE 1, CST 1	DR 3, CST 1, WHC 1, CC 1
		SF	CR		A3	–	CR			
		NF	NT	NT–VU	A1, A3	=	NT			
S06.06	Calcareous fens	F	CR		A3	–		4	AGCL 3, DR 3, OGR 2, CST 1, EXT 1	DR 3, OGR 2, EXT 1, GWA 1, WHC 1, CST 1
		SF	CR		A3	–		4		
		NF	EN		A3	=		4		
S06.07	Rich *Calliergon richardsonii* flark fens	F	VU		B1b	?		4	DR 1, AGCL 1, WHC 1, CST 1	DR 2, EXT 2, CST 1, WHC 1, CC 1
		SF								
		NF	VU		B1b	?		4		
S07	**Swamps**									
S07.01	Wooded swamps	F	DD		A1–A3, CD1–CD3	–	VU	3	WHC 3, WBR 3, DR 3, AGCL 2, CST 2, F 2, GWA 1	DR 2, WBR 2, F 2, WHC 1, CST 1, AGCL 1, GWA 1
		SF	DD		A1–A3, CD1–CD3	–	VU	3		
		NF	DD		A3, CD1–CD3	=	LC	3		
S07.01.01	Birch swamps	F	DD		A1–A3, CD1–CD3	–	NT	3	WHC 3, WBR 3, DR 3, AGCL 2, CST 2, F 2	DR 2, WBR 2, F 2, WHC 1, CST 1, AGCL 1
		SF	DD		A1–A3, CD1–CD3	–	VU	3		
		NF	DD		A3, CD1–CD3	=	LC	3		
S07.01.02	Black alder swamps	F	EN	EN–CR	A3	–	VU	3	WHC 3, WBR 3, DR 3, AGCL 2, CST 2, F 1, GWA 1	DR 2, CST 2, GWA 2, WBR 1, F 1, WHC 1, IAS 1
		SF	EN	EN–CR	A3	–	VU	3		
		NF								
S07.01.03	Grey alder swamps	F	EN	EN–CR	A1	–	CR	3	DR 3, AGCL 3, CST 2, WHC 1, F 1	DR 2, CST 2, F 1, WHC 1, AGCL 1
		SF	EN	EN–CR	A1	–	CR	3		
		NF								
S07.02	Shrub swamps	F	LC			–	LC			DR 2, WBR 2, CST 1, WHC 1, IAS 1
		SF	LC			–	NT	3		
		NF	LC			=	LC			
S07.02.01	*Salix* swamps	F	LC			–	NT	3		DR 2, WBR 2, CST 1, WHC 1, IAS 1
		SF	LC			–	NT	3		
		NF	LC			=	LC			
S07.02.02	Northern *Salix* swamps	F	LC			=	LC			
		SF								
		NF	LC			=	LC			
S07.02.03	*Myrica gale* swamps	F	VU	NT–VU	A1	–	EN	3	DR 2, CST 2, WHC 1, WBR 1	DR 2, CST 2, WHC 1, AGCL 1, OGR 1
		SF	VU	NT–VU	A1	–	EN	3		
		NF								
S07.03	Open swamps	F	LC			–	LC			DR 2, WBR 2, OGR 2, WEP 2, WHC 1, CST 1, IAS 1
		SF	DD		CD1–CD3	–	NT	3		
		NF	LC			=	LC			
S08	**Low-productive seasonal wetlands**	F	DD		A1–A3, CD1–CD3	–	DD			DR 2, EXT 1, GWA 1, F 1, CST 1, AGCL 1
		SF	DD		A1–A3, CD1–CD3	–	DD			
		NF	DD		A1–A3, CD1–CD3	?	DD			

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

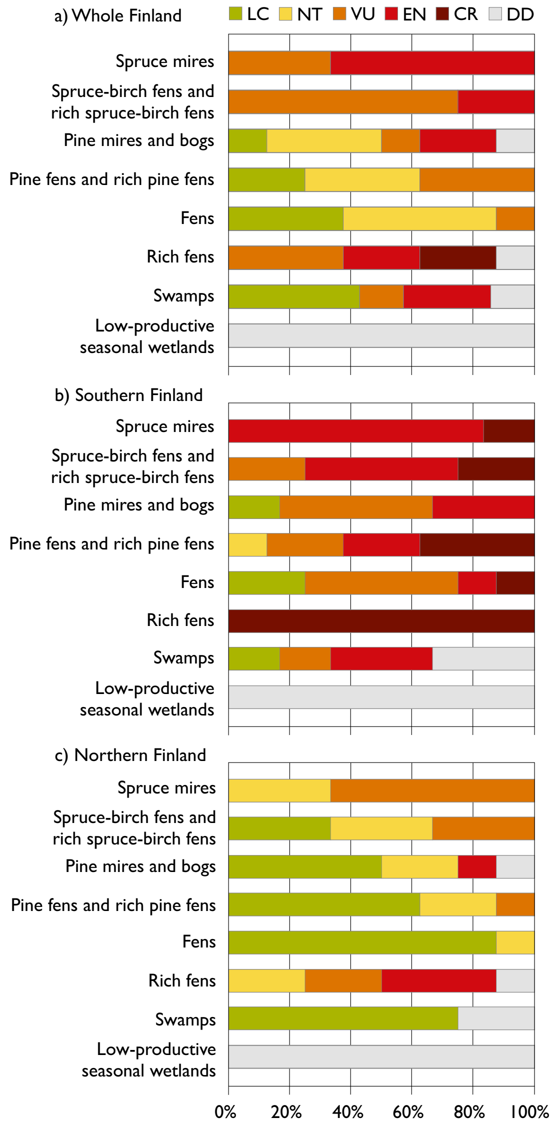

Figure 4.25. Breakdown of mire habitat types into IUCN Red List categories in the whole of Finland, Southern Finland and Northern Finland by main group of habitats (percentages of numbers of habitat types at the lowest level of hierarchy). Figures on the right show the numbers of assessed habitat types for each of the main groups in the given region.

On the basis of the results of Finland's 11th National Forest Inventory (NFI 11), it can be roughly estimated that around 35–40% of the country's undrained mire area can be found in threatened mire habitat types, around 40% in Near Threatened (NT) ones and around 20% in ones that are classified as Least Concern (LC).

Southern Finland

Of the 46 mire habitat types found in Southern Finland (i.e. in the hemiboreal, south boreal and middle boreal zones), 38 types or 83% were assessed as threatened, 2% as Near Threatened (NT), 9% as Least Concern (LC) and 7% as Data Deficient (DD) (Figure 4.24). Of the threatened habitat types, 13 types (28% of the assessed habitat types) were classified as Critically Endangered (CR), 14 (30%) as Endangered (EN) and 11 (24%) as Vulnerable (VU). In Southern Finland, threatened mire habitat types can be found in all of the main type groups, most commonly among spruce mires, spruce-birch fens and rich spruce-birch fens as well as among rich fens (Figure 4.25). The majority of pine mire and bog, pine fen and rich pine fen as well as fen types are also threatened. One third of swamp types are assessed as Data Deficient (DD). Mire habitat types that are Critically Endangered (CR) in Southern Finland comprise thin-peated spruce mires as well as all rich fens, rich pine fens and rich spruce-birch fens. Classified as Endangered (EN) are the spruce mire habitat types of thin-peated rich spruce mires and herb-rich spruce mires as well as dwarf-shrub spruce mires including their sub-types; the spruce-birch fen habitat types of tall-sedge spruce-birch fens and *Carex nigra* birch fens; the pine mire and bog habitat types of thin-peated pine mires and spruce-pine mires; the pine fen habitat type of tall-sedge pine fens; and the wooded swamp habitat types of black alder and grey alder swamps. Only 4 mire types of Southern Finland were classified as Least Concern (LC): *Sphagnum fuscum* bogs; the fen habitat types of hollow bogs and ombrotrophic low-sedge bogs; and the shrub swamp habitat type of *Salix* (willow) swamps. Classified as Data Deficient (DD) in Southern Finland were the wooded swamp habitat type of birch swamps, open swamps as well as low-productive seasonal wetlands.

Northern Finland

Altogether 12 mire types or 26% of the types assessed in Northern Finland (i.e. in the north boreal zone) were classified as threatened (Figure 4.24). A total of 22% of the mire types were assessed as being Near Threatened (NT), 43% as Least Concern (LC) and 9% as Data Deficient (DD). A total of 4 threatened habitat types (9% of the assessed habitat types) were assessed as being Endangered (EN) and 8 (17%) as Vulnerable (VU).

As in Southern Finland, in Northern Finland, too, the state of rich fens, spruce mires as well as spruce-birch fens and rich spruce-birch fens has deteriorated the most (Figure 4.25). There are no habitat types classified as Least Concern (LC) among spruce mires or rich fens. On the other hand, there are no mire habitat types assessed as being threatened in the group of fens. Moderately rich fens are, however, classified as Near Threatened (NT). In the swamps group, open swamps and shrub swamps are classified as LC but birch swamps as Data Deficient (DD). Endangered (EN) mire habitat types in Northern Finland comprise palsa bogs, which are threatened by climate change, and the rich fen types of rich birch lawn fens, rich lawn fens and calcareous fens. Vulnerable (VU) ones are found among the spruce mire types (thin-peated spruce mires, thin-peated rich spruce mires, *Equisetum sylvaticum* spruce mires and *Rubus chamaemorus* spruce mires) as well as among the eutrophic types (rich spruce-birch fens, mire margin influenced rich pine fens, rich birch flark fens and rich *Calliergon richardsonii* flark fens). Classified as Data Deficient (DD) are pounikkos, rich swamp fens, birch swamps and low-productive seasonal wetlands.

Criterion-specific results and criteria decisive for the final IUCN Red List categories

The assessment of mires at the habitat type level aimed to examine quantitative changes (criterion A), geographic distribution (criterion B) and qualitative changes (usually criteria C/D combining abiotic and biotic quality and sometimes criterion C or D), excluding the subcriteria, which examine a period of 50 years including the past as well as the future (A2b, C/D2b; Figure 4.26). A quantitative risk analysis concerning the probability of collapse (E) was applied to one type – palsa bogs. A large proportion of the qualitative assessments ended up being Data Deficient (DD). In most cases the assessment of quantitative changes over the next 50 years (criterion A2a) was likewise DD.

The final IUCN Red List category was usually determined on the basis of quantitative changes (criterion A1, A3 or both) being decisive as criteria (Table 4.4).

Trends

At the nationwide level, the trend for 38 mire types/mire type groups (taking into account assessment units at the lowest classification level) or 76% of those assessed was regarded as still declining and for 11 (22%) as stable (Table 4.4) over the short term. A declining trend is usually due to hydrological disturbances caused by drainage and other land use in the surrounding areas or, as is the case for some spruce mire types, by forestry measures. The declining trend of frost bogs and mires is caused by the impacts of climate change.

Mire habitat types assessed as undergoing a stable trend include ombro- and oligotrophic pine mires and bogs, pine fens and fens that are not sensitive to drying caused by hydrological disturbances and may even increase due to drying (as in the case of dwarf-shrub pine bogs and mires, *Eriophorum vaginatum* pine bogs and mires, *Sphagnum fuscum* bogs, *Sphagnum papillosum* pine fens and low-sedge fens). Stable habitat types also include ombrotrophic mire vegetation of central parts of raised bogs that are unlikely to be subjected to further land use pressure (ridge-hollow pine bogs, hollow bogs and ombrotrophic low-sedge bogs). There was one habitat type (rich *Calliergon richardsonii* flark fens) whose trend could not be assessed at the nationwide level.

When examined at the subregional level, in Southern Finland 83% of the assessed habitat types were undergoing a declining trend and 17% were stable. In Northern Finland those undergoing a stable trend were the largest group at 63%, while 30% of the habitat types were declining and the trend for 3 habitat types (7%) was unknown (rich spruce-birch fens, rich *Calliergon richardsonii* flark fens and low-productive seasonal wetlands). As regards rich spruce-birch fens, for example, there was insufficient data concerning the extent to which the reformed Forest Act (1093/1996) safeguards their occurrences and the extent to which occurrences suffer from forestry measures and remote impacts of surrounding land use.

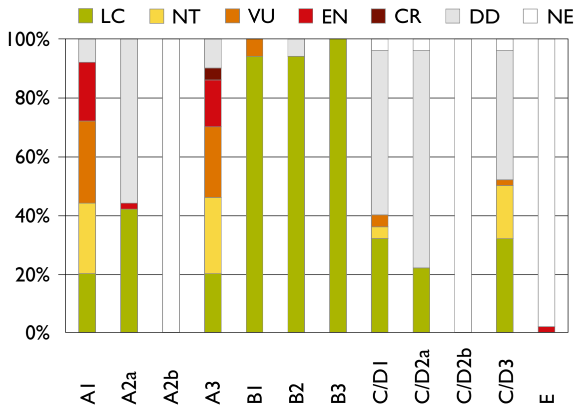

Figure 4.26. Mire habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria for the whole of Finland. The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. The figure only includes assessment units at the lowest hierarchical level of the classification (50 types)

4.4.3
Threat status of mire habitat complex types

Mire habitat complexes – mire complexes and mire succession series of the land uplift coast – have also become threatened particularly in Southern Finland (i.e. in the hemiboreal, south boreal and middle boreal zones) (Table 4.5, Figure 4.27).

Whole country

At the level of the whole of Finland, of the total of 19 classified mire habitat complex types, altogether 12 types or 63% were assessed as being threatened (VU, EN or CR), 16% as Near Threatened (NT) and 21% as Least Concern (LC). No habitat complex types were classified as Data Deficient (DD). Classified as Critically Endangered (CR) were southern fen complexes as well as raised bog and aapa mire succession series of the land uplift coast. There are also 3 Endangered (EN) habitat complex types – middle boreal aapa mires, coastal mires and succession series of small mires on the land uplift coast. There are 6 nationally Vulnerable (VU) mire habitat complex types: 3 raised bog types (plateau and heath raised bogs, concentric raised bogs and wooded raised bogs), middle boreal sloping fens, palsa mires and local mire complexes. There are 3 Near Threatened (NT) mire habitat complex types: eccentric raised bogs, *Sphagnum fuscum* raised bogs and the southern subtype of northern boreal aapa mires. Altogether 4 mire habitat complex types classified as Least Concern (LC) are found only in Northern Finland: northern reticulate raised bogs, the northern subtype of northern boreal aapa mires, northern boreal sloping fens, and fell mires.

Southern Finland

All of the 13 mire habitat complex types assessed in Southern Finland are threatened (VU, EN or CR). The Critically Endangered (CR) ones comprise southern fen complexes and raised bog and aapa mire succession series of the land uplift coast and the Endangered (EN) ones are middle boreal aapa mires, coastal mires, local mire complexes, and succession series of small mires on the land uplift coast. The Vulnerable (VU) mire habitat complex types comprise all raised bog types and middle boreal sloping fens. No mire complex types were assessed as being Near Threatened (NT) or Least Concern (LC) in Southern Finland.

Northern Finland

A total of 78% of the assessed 9 mire habitat complex types in Northern Finland are in the Least Concern (LC) category. Northern Finland's only mire habitat complex type assessed as being threatened is the Vulnerable (VU) palsa mires. The southern subtype of northern boreal aapa mires was classified as Near Threatened (NT).

It is noteworthy that, even though all subtypes of raised bogs are classified as being threatened in Southern Finland, the typical mire types of the central parts of raised bog complexes (*Sphagnum fuscum* bogs, ombrotrophic low-sedge bogs and hollow bogs) were assigned the category of Least Concern (LC) in Southern Finland and ridge-hollow pine bogs are classified as Near Threatened (NT) (section 4.4.2). This is due to the fact that raised bogs as mire complexes are rarely fully natural entities. The mire types of raised bog centres have been preserved on average better than the types in the peripheral parts of the complexes. In Northern Finland, the majority of mire complexes are in turn classified as LC, although some mire types of aapa mires, such as rich fens, have become threatened.

Criterion-specific results and criteria decisive for the final IUCN Red List categories

Data used in the threat status assessments of mire habitat complexes consisted in particular of data on geographic distribution (criterion B) as well as historical changes in quality (criterion CD3) but also changes in quantity (criterion A) (Figure 4.28). Both a quantitative change (criteria A1 and A3 or A3 alone) as well as a historical change in quality (CD3) was equally often the decisive criterion for the determination of the final IUCN Red List category (Table 4.5). For plateau and heath raised bogs as well as middle boreal sloping fens, the category was determined on the basis of the rarity-related criteria B1 and B2 being decisive. For palsa mires, their restricted extent of occurrence (B1) and historical change in quality (CD3) both warranted the assignment of category.

The longer-term historical time frame was more important in determining the IUCN Red List category than the recent time frame of the past 50 years. Future changes in quantity and quality remained in general Data Deficient (DD) and predictions of future changes did not determine the category of any mire complex type.

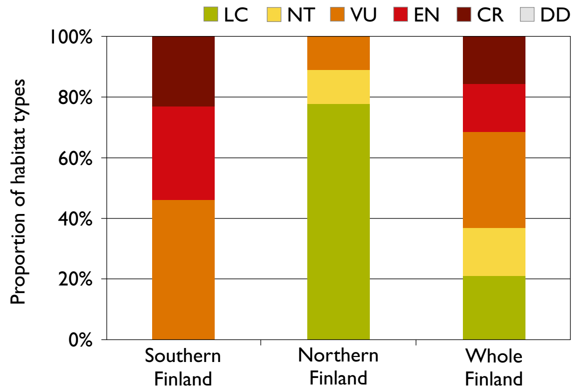

Figure 4.27. Breakdown of mire habitat complex types into IUCN Red List categories by percentage of number of habitat types in Southern Finland (13 types), Northern Finland (9 types) and the whole of Finland (19 types).

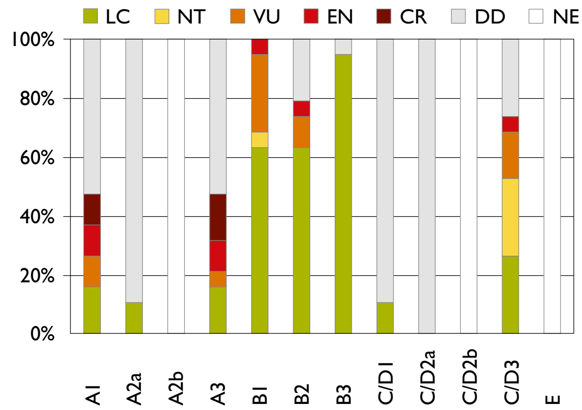

Figure 4.28. Mire habitat complex type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria for the whole of Finland (19 types). The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. Assessments of qualitative changes used the combined criterion CD that includes both abiotic and biotic changes.

Trends

At the nationwide level, 15 mire habitat complex types or 79% of those assessed were regarded as still undergoing a declining trend and 3 types (21%) as being stable over the short term (Table 4.5). Decline is caused especially by forestry, such as the impacts of previous drainage and, for aapa mires in particular, its remote impacts, supplementary drainage and ditch network maintenance, forest cutting and subsequent mechanical soil manipulation. Construction alters water flows on slopes and directly impairs the quality of sloping fens. Coastal mires and mire succession series of the land uplift coast are subjected to various types of land use pressure, such as clearing for agriculture, construction and forestry. Rising temperature caused by climate change is accelerating the thawing of palsa formations and pounikkos and preventing the creation of new frost formations. The trend was regarded as stable for two types only occurring in Northern Finland – northern reticulate raised bogs and the northern subtype of

Table 4.5. Results of the threat status assessment of mire habitat complex types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
S09	**Mire complexes**									
S09.01	Raised bogs									
S09.01.01	Ridge-hollow raised bogs									
S09.01.01.01	Plateau and heath raised bogs	F	VU		B1,2a(ii,iii)	–	NT	3, 2	DR 2, AGCL 1, F 1, PE 1, ADE 1	DR 1, F 1, ADE 1
		SF	VU		B1,2a(ii,iii)	–	NT	3, 2		
		NF								
S09.01.01.02	Concentric raised bogs	F	VU	VU–EN	CD3	–	NT	3	DR 2, PE 2, AGCL 1, F 1, CST 1, ADE 1	DR 2, PE 1, F 1, OTF 1, ADE 1
		SF	VU	VU–EN	CD3	–	NT	3		
		NF								
S09.01.01.03	Eccentric raised bogs	F	NT	NT–VU	CD3	–	VU	3	DR 3, PE 2, AGCL 1, F 1, CST 1, ADE 1	PE 2, DR 2, F 1, OTF 1, ADE 1
		SF	VU		CD3	–	VU			
		NF	LC			=	LC			
S09.01.01.04	Northern reticulate raised bogs	F	LC			=	LC			CC 1
		SF								
		NF	LC			=	LC			
S09.01.02	Wooded and *Sphagnum fuscum* raised bogs									
S09.01.02.01	Wooded raised bogs	F	VU		CD3	–	EN	3	DR 3, F 2, PE 1, CST 1	F 2, DR 2
		SF	VU		CD3	–	EN	3		
		NF								
S09.01.02.02	*Sphagnum fuscum* raised bogs	F	NT	NT–VU	CD3	=	VU	3	DR 2, PE 2, CST 1, AGCL 1, ADE 1	PE 2, DR 1, ADE 1, OTF 1
		SF	VU		CD3	=	VU			
		NF	LC			=	LC			
S09.02	Aapa mires									
S09.02.01	Middle boreal aapa mires	F	EN	VU–EN	CD3	–	EN		DR 3, AGCL 2, PE 2, F 1, CST 1, WHC 1, GWA 1, OGR 1	DR 3, PE 2, F 2, CC 2, AGCL 1, GWA 1, OTF 1, OGR 1
		SF	EN	VU–EN	CD3	–	EN			
		NF					NT	5		
S09.02.02	Northern boreal aapa mires									
S09.02.02.01	Southern subtype of northern boreal aapa mires	F	NT	LC–NT	CD3	–	LC	3	DR 2, AGCL 2, PE 1, F 1, CST 1, WHC 1, GWA 1, OGR 1	DR 2, PE 1, F 1, WHC 1, EXT 1, CC 1
		SF								
		NF	NT	LC–NT	CD3	–	LC	3		
S09.02.02.02	Northern subtype of northern boreal aapa mires	F	LC			=	LC			CC 1
		SF								
		NF	LC			=	LC			
S09.03	Southern fen complexes	F	CR		A3	–		4	AGCL 3, DR 2, PE 1, CST 1, GWA 1, WHC 1, OGR 1	DR 2
		SF	CR		A3	–		4		
		NF								
S09.04	Sloping fens									
S09.04.01	Middle boreal sloping fens	F	VU		B1,2a(i,ii,iii)b	–	VU		DR 2, F 2, CST 1	F 2, DR 2, CST 1
		SF	VU		B1,2a(i,ii,iii)b	–	VU			
		NF								
S09.04.02	Northern boreal sloping fens	F	LC			–	LC			F 1, DR 1, CST 1, MW 1
		SF								
		NF	LC			–	LC			
S09.05	Palsa mires	F	VU		B1a(ii,iii)b, CD3	–	NT	3, 2	CC 2, MW 1, GP 1	CC 3, MW 1, GP 1
		SF								
		NF	VU		B1a(ii,iii)b, CD3	–	NT	3, 2		
S09.06	Fell mires	F	LC			?	LC			CC 1, GP 1, MW 1
		SF								
		NF	LC			?	LC			
S09.07	Coastal mires	F	EN		A3	–		4	DR 3, F 3, AGCL 2, CST 2, OGR 1, WHC 1	F 3, DR 3, CST 2, AGCL 1, OGR 1, OTF 1
		SF	EN		A3	–		4		
		NF								

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
S09.08	Local mire complexes	F	VU	VU–EN	A1, A3	–	DD	2	DR 3, F 3, AGCL 2, CST 2, GWA 1, OGR 1, WHC 1, WBR 1, EXT 1	F 3, DR 3, AGCL 1, CST 1, GWA 1, OGR 1, WHC 1, WBR 1, EXT 1
		SF	EN	VU–EN	A1, A3	–	DD	2		
		NF	LC			–	DD	2		
S10	**Mire succession series of land uplift coast**									
S10.01	Raised bog succession series of land uplift coast	F	CR	EN–CR	A1, A3	–	CR		DR 3, AGCL 3, F 3, CST 2, OGR 1, WHC 1	DR 3, F 3, CST 2, AGCL 1, OGR 1
		SF	CR	EN–CR	A1, A3	–	CR			
		NF								
S10.02	Aapa mire succession series of land uplift coast	F	CR	EN–CR	A1, A3	–	CR		DR 3, AGCL 3, F 3, CST 2, OGR 1, WHC 1	DR 3, F 3, CST 2, AGCL 1, OGR 1
		SF	CR	EN–CR	A1, A3	–	CR			
		NF								
S10.03	Succession series of small mires on land uplift coast	F	EN		A1, A3	–		4	DR 3, F 3, AGCL 2, CST 2, OGR 1, WHC 1	DR 3, F 3, CST 2, AGCL 1, OGR 1
		SF	EN		A1, A3	–		4		
		NF								

northern boreal aapa mires – and for *Sphagnum fuscum* raised bogs, which are still common throughout the country. The short-term trend for fell mires could not be assessed because the potential impacts of climate change, reindeer grazing pressure and off-road vehicle use on the quality of fell mires are unknown. None of the mire habitat complex types were assessed as improving in the near future.

In Southern Finland, only *Sphagnum fuscum* raised bogs were assessed stable as regards their short-term trend and all other mire habitat complex types were assessed as declining. The trend for the southern subtype of northern boreal aapa mires, northern boreal sloping fens, palsa mires and local mire complexes was assessed as declining in Northern Finland. In Northern Finland, the trend was assessed as stable for eccentric and northern reticulate raised bogs, *Sphagnum fuscum* raised bogs as well as for the northern subtype of northern boreal aapa mires.

4.4.4

Reasons for becoming threatened and threat factors

The increased threat status of mire habitats is caused by various types of land use, and Finland's history of mire exploitation dates back hundreds of years. The country's original biological mire area covered around 10.4 million hectares (Ilvessalo 1956). Some of the human uses of mires have resulted in the loss of almost 1.7 million hectares of the total area of mires and drained peatlands. Reduction has been caused by measures including clearing for agriculture, peat extraction, transformation of thin-peated drained peatlands into mineral soil forests, hydraulic construction and other construction. According to the results of Finland's 11th National Forest Inventory (NFI11), the current area of mires and drained peatlands totals 8.8 million hectares (NFI11 2016; Korhonen et al. 2017) while the area of undrained mires totals 4.1 million hectares (around 40% of the original mire area). Of the undrained mires, 1.7 million hectares are located in Southern Finland (0.34 million hectares in the hemiboreal and south boreal zones and 1.34 million hectares in the middle boreal zone) and 2.4 million hectares in Northern Finland (NFI11 2016). In the 1950s undrained mires covered around 8.8 million hectares (Ilvessalo 1956) or around 84% of the original mire area and in the 1960s around 6.6 million hectares (NFI5 2016) or 63% of the original mire area.

The most significant reason for both habitat complex types and individual habitat types becoming threatened is drainage for forestry (Figures 4.29 and 4.30). Drainage has reduced the number of mires and impaired the structural and functional quality of mire complexes. Remote impacts on mire hydrology of drainage carried out further away have caused drying and consequent quality deterioration (Rehell et al. 2016; Rehell 2017).

Clearing for agriculture has also been a significant factor altering mire habitats, especially in Southern Finland. Forestry measures in undrained mires or their immediate vicinity have impaired the quality of undrained mires due to alteration of the natural tree stand structure, reduction of the amount of deadwood and impacts on microclimate. The most significant change factors have also included construction, including road networks, peat extraction and hydraulic construction.

Although the threats faced by mire habitat types have, compared with past decaded, generally been reduced thanks to advancements such as discontinuation of new drainage for forestry, introduction of legislative reforms, development of forest management recommendations and policies laid out in a Government resolution (Government 2012), the remaining mires still face a considerable number of threats. Many types of human activities may still reduce the number of mires, but especially their quality (structure, functional features and species). Undrained mires are still subjected to tree cutting and mechanical soil manipulation, and surrounding land use causes remote hydrological

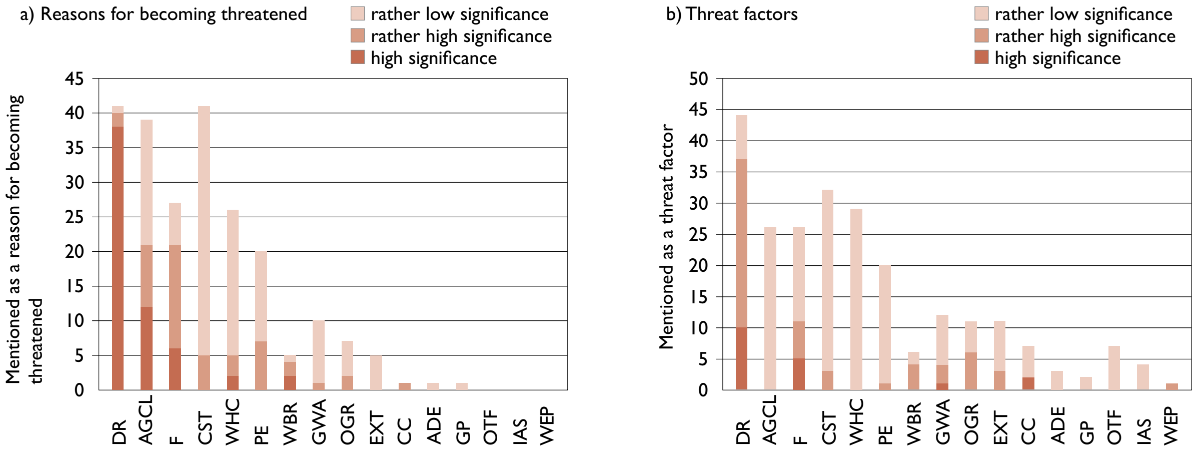

Figure 4.29. Reasons for becoming threatened (a) and threat factors (b) of mire habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

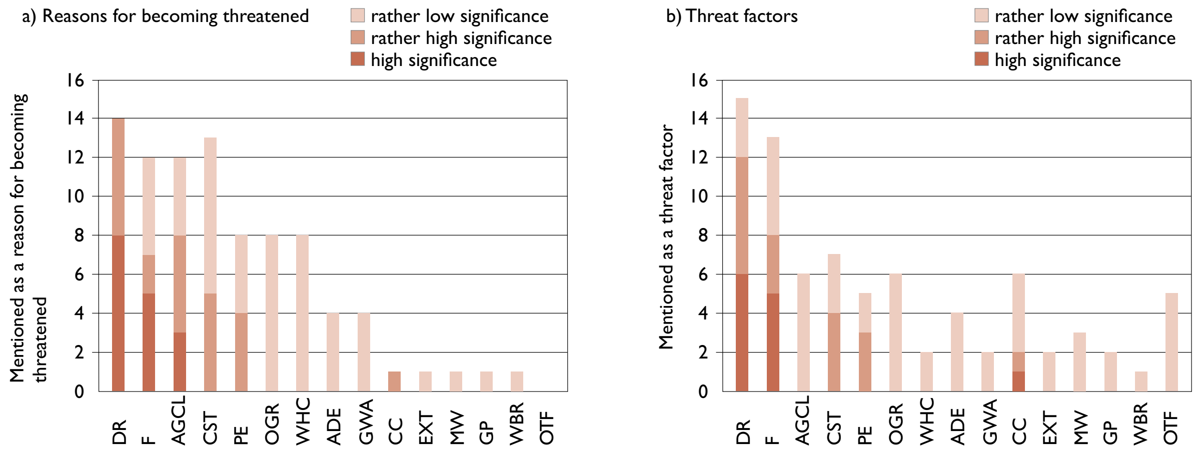

Figure 4.30. Reasons for becoming threatened (a) and threat factors (b) of mire habitat complex types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

Figure 4.31. Palsas that are 1–2 metres high in Soavveljeaggi, Inari. Pictured in front is a pool formed by palsa thawing that is covered by *Sphagnum* spp. moss. Photo: Markku Mikkola-Roos

impacts on them. The impacts of peatland forest use, old drainage and ditch network maintenance are even threatening to increase. The future threats are largely the same as the reasons that have caused mire habitat types to become threatened, but the significance of the various threat factors has to some extent changed. Especially clearing for agriculture but also construction, peat extraction and hydraulic construction are less significant as future threats than as reasons for habitat types having become threatened. There was, however, a new upturn in the total area of peatland fields cleared at the start of the 2000s (Regina 2015).

Threats growing in significance include mining, moss collection (included in other threats under the code OTF in Figures 4.29 and 4.30) and climate change. Climate change is assessed as having an impact already in the next decades at least on those mire complexes and mire types where mire structure and vegetation is shaped by frost heaving. The biggest risk is faced by frost bogs and mires, such as palsa bogs (Fronzek et al. 2006; Fronzek 2013) (Figure 4.31), and the mire complex types of palsa mires, northern reticulate raised bogs and the northern subtype of northern boreal aapa mires, which typically contain frost bogs and mires. Over the longer term, however, climate change will also have a broader impact on mires. The potential impacts of climate change on mire vegetation are discussed in Fact box 4.2.

Drainage of mires

Drainage has changed Finland's mires more than anything else. Most of the drainage comprises drainage for forestry to increase timber production. Systematic mire drainage started in the early 1900s. The late 1960s and the 1970s especially were the periods of most intensive drainage for forestry, but the practice still continued until the 1990s. In the early stages, drainage focused particularly on spruce mires, tall-sedge pine fens and thin-peated pine mires (Keltikangas et al. 1986) and later on more extensively also on others, including ombro- and oligotrophic mires and bogs (e.g. Eurola et al. 1991; Hökkä et al. 2002). Rich fens used to be regarded for a long time as suitable drainage sites, but it was later found that the nutrient economy of centre-influenced rich fens is often unsuitable for silviculture (e.g. Heikurainen 1985).

In the 1950s, only 9% of the area then covered by mires was drained at the nationwide level (NFI3; Ilvessalo 1956; 1957). By the 1960s, the nationwide percentage of drained mires had already risen to 32% (NFI5 2016). At that time, drained mires accounted for 42% in the subregion of Southern Finland (hemiboreal, south boreal and middle boreal zones) used in the assessment of threatened habitat types and for 11% in Northern Finland (north boreal zone). According to the results of Finland's 11th National Forest Inventory (NFI11 2016), the corresponding percentages were 53% in the whole of Finland, 71% in Southern Finland and 21% in Northern Finland. Particularly intensive drainage in the hemiboreal, south boreal and middle boreal zones has resulted in the area of undrained mires focusing increasingly on Northern Finland (Figure 4.32). In Northern Finland, drainage has focused on the southern parts of the subregion up to the municipalities of Kolari, Kittilä, Sodankylä, Pelkosenniemi and Salla (Figure 4.33).

Non-stringent drainage criteria also used to result in unprofitable drainage (Heikkilä 1984; Keltikangas et al. 1986; Eurola et al. 1991; Kalpio 1998; Hökkä et al. 2002; Kojola et al. 2015; Laiho et al. 2016; Korhonen et al. 2017). Also contributing to the adverse effects was the mire classification applied within forestry that oversimplified the diversity and ecology of mire habitats (Eurola and Holappa 1984). Estimates of the total area of low-productive drained mire areas have varied in

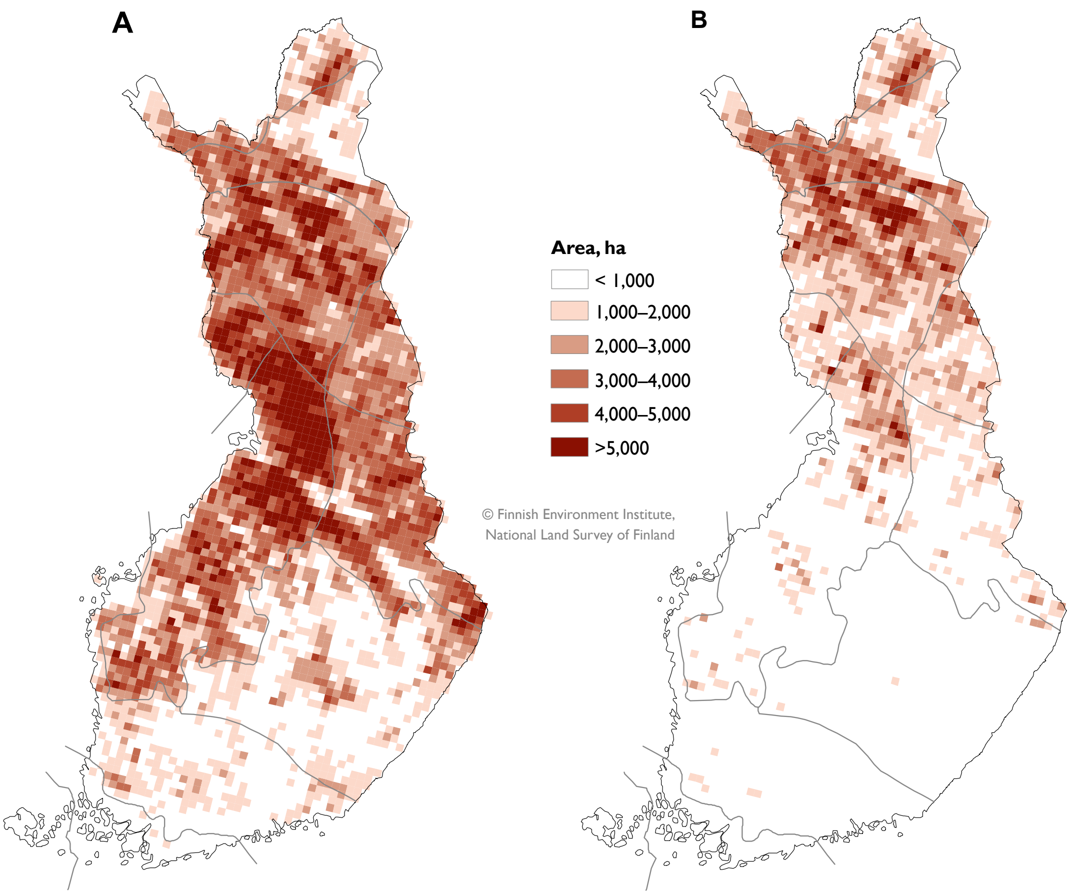

Figure 4.32. Total combined area of all peatlands (a) and undrained peatlands (b) in the EEA 10 x 10 km^2 reference grid (EEA reference grid 2018).

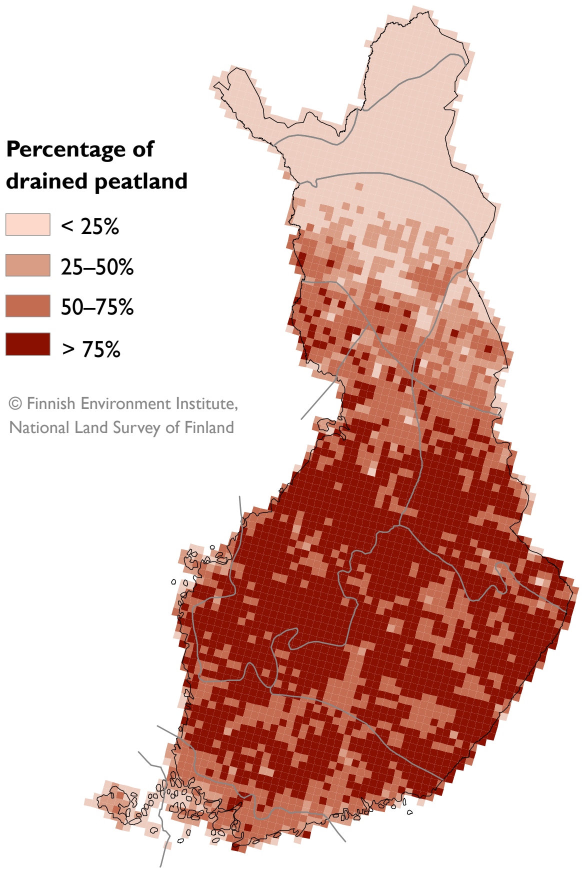

Figure 4.33. Percentages of drained peatlands of all peatlands in the EEA 10 x 10 km² reference grid (EEA reference grid 2018).

studies between 0.5 and 1 million hectares (e.g. Laiho et al. 2016; Korhonen et al. 2017).

Drainage of previously undrained mires has in practice ended and the focus has switched to ditch network maintenance. Drainage of pristine mires on state-owned land was discontinued in 1994 (Korhonen and Savonmäki 1997) and, following the 1997 entry into force of the Act on the Financing of Sustainable Forestry, no forest improvement funds have been granted by the State of Finland for drainage of previously undrained mires on privately owned land. Efforts have also been made to reduce new drainage through forest management recommendations concerning peatland (e.g. Ruotsalainen 2007; Äijälä et al. 2014; Kaukonen et al. 2018) and through forest certification criteria (FSC Finland 2011; PEFC Finland 2014).

The forestry use of certain mire habitat types of special importance is restricted under the Forest Act (1093/1996, section 10). Many of the assessed mire habitat types are partly covered by the habitat types of special importance under Forest Act. These are part of thin-peated rich spruce mires, herb-rich spruce mires, *Equisetum sylvaticum* and *Rubus chamaemorus* spruce mires, rich fens, swamps and some mires on poorly productive forest land and unproductive land. According to amendments to the Forest Act that entered into force in 2014, these habitats of special importance should be such that are "in their natural or semi-natural state and can be clearly distinguished from the surrounding forest nature". Only sites that "are small in area or have little significance for forestry purposes can be interpreted as habitats of special importance". Shortcomings have been observed previously in detecting and identifying the Act's habitats of special importance and in taking their characteristic features into account in forestry measures (Kajava et al. 2002; Ohtonen et al. 2005; Pykälä 2007; Fredrikson 2008; Juutinen and Kotiaho 2009; 2011). For the purpose of safeguarding mire habitat types, it would be necessary to conduct a study on the effectiveness of habitat type protection under the reformed Forest Act and the practical application of such protection.

The impacts of old drainage as well as ditch network maintenance and complementary drainage are assessed as posing the most significant future threat both to mire habitat types and to mire habitat complex types. In addition to ditch clearing, ditch network maintenance involves complementary drainage and in some cases ditches may also be dug in individual patches of mire that had previously not been drained (e.g. Silver et al. 2008). The impact of drainage on undrained mire sections mainly occurs through remote hydrological impacts. The total combined annual area target for ditch network maintenance set in Finland's regional forest programmes for the 2016–2020 period is 67,350 hectares (Leinonen 2018). Until 2015, ditch network maintenance took place in Finland annually over an area covering around 60,000 hectares, but in recent years the outcome has been below the target and, for example, in 2017 totalled around 33,450 hectares.

In 2014, the obligation to regenerate the forest after felling was removed from the Forest Act as regards drained areas with low wood production potential and with respect to areas where originally open and sparse-wooded mires are restored. The re-use options for low-productive drained peatlands have been explored in the LIFE PeatLandUse project (Tolvanen et al. 2018). Some unprofitable drained sites are likely to be left unmanaged and undergo slow recovery back into mires. This will not, however, increase the area of pristine mire types in the near future. Ditch drainage has frequently changed the properties of surface peat, and the area often has functioning ditches further away that still continue to alter water flows.

Other forestry use

Forest operations in undrained wooded mires (felling, mechanical soil manipulation in conjunction with regeneration) impair the quality of mire habitat types. Forestry measures have commonly taken place in wooded parts of mire complexes as well as in ecotones between mires and mineral soil, and many local mire complexes that are small in area have been processed as part of larger forest compartments. In the future, forestry measures are projected to pose the greatest threat for the mire habitat complex types of mire succession series of the land uplift coast, middle boreal aapa mires and sloping fens as well as coastal mires and local mire complexes (Table 4.5). At the habitat type level, forest operations in undrained mires constitute the most important reason for spruce mire types and wooded pine mire and bog types becoming threatened and forestry is also their most significant future threat (Table 4.4).

According to the results of Finland's 11th National Forest Inventory calculated for the threat status assessment (NFI11 2016), in Southern Finland felling had taken place in 49% of the surface area of undrained spruce mires with forest land and poorly productive forest land (including spruce-birch fens and rich spruce-birch fens) over the past 30 years. In Northern Finland the percentage is 9% and nationwide 20%. During the past 10 years, the percentage of the surface area of undrained forest land and poorly productive forest land spruce mires where felling measures have been carried out is 22% in Southern Finland, 4% in Northern Finland and 13% in the whole country. Tree felling in undrained mires has been most intensive in *Vaccinium myrtillus* spruce mires, which are included in *Vaccinium* spruce mires in this assessment, (44% in the past 30 years nationwide) as well as thin-peated spruce mires (43%), with the percentage for thin-peated rich spruce mires and herb-rich spruce mires also exceeding 30% (NFI11 2016). During the past 10 years, felling has, depending on the type, taken place in 13–19% of the undrained forest land and poorly productive forest land area of the above-mentioned spruce mire types. The forestry measures have usually included forest thinning and tending of seedling stands. In spruce mires, final felling usually involves soil preparation. In the NFI, soil preparation data is collected from mires on forest land. According to NFI11 (2016), mechanical soil manipulation has taken place on average in 6% of the area of undrained forest land spruce mires (including spruce-birch fens and rich spruce-birch fens) over the past 30 years and in 3% over the past 10 years.

Longer-term forestry impacts on the quality of undrained mires are indicated by the NFI's naturalness variables, including the structure of the growing stock (Finnish Forest Research Institute 2013). According to the results of NFI11 (NFI11 2016), 43% of the area of the total of Finland's undrained spruce mires (including spruce-birch fens and rich spruce-birch fens) is even in terms of the distribution of growing stock and uniform in terms of the species and size distribution of trees as a result of, for example, cultivation or thinning. The corresponding percentage in Southern Finland is 62% and in Northern Finland 25%. At the mire type level, the percentages are highest for *Vaccinium myrtillus* spruce mires (65% at the nationwide level), thin-peated spruce mires (58%), thin-peated rich spruce mires (57%) and herb-rich spruce mires (43%).

According to the NFI11 results, the percentage of the area of undrained forest land and poorly productive forest land pine mires and bogs (including pine fens and rich pine fens) where felling has taken place over the past 30 years is 23% in Southern Finland, 5% in Northern Finland and 13% in the whole country. Over the past 10 years, felling had taken place in Southern Finland in 8%, in Northern Finland in 2% and in the whole country in 5% of such pine mires and bogs. The differences between the habitat types were big. The percentages of mires where felling had taken place were highest for thin-peated pine mires (23% nationwide over the past 30 years) and spruce-pine mires (21%), followed by dwarf-shrub pine bogs and mires and *Carex globularis* pine mires. Forestry operations in *Eriophorum vaginatum* pine bogs and mires, *Sphagnum fuscum* bogs and pine fens have been clearly less extensive. According to the results of NFI11 for the structure of the growing stock, 29% of the area of the total of Finland's undrained pine mires and bogs (including pine fens and rich pine fens) is even in terms of the distribution of growing stock and uniform in terms of the species and size distribution of trees as a result of, for example, cultivation or thinning. The corresponding percentage in Southern Finland is 31% and in Northern Finland 28%. At the mire type level the percentages are highest for spruce-pine mires (55% at the nationwide level), thin-peated pine mires (50%), *Carex globularis* pine mires (classified in accordance with the NFI, 48%) and dwarf-shrub pine mires and bogs (31%).

Legislative provisions on forestry measures are laid down in the Forest Act (1093/1996). Under the Act, in habitats of special importance (referred to in section 10 of the Act) "cautious management and utilisation operations may be undertaken where the characteristic features of the habitats are preserved or reinforced" (section 10a of the Act). Under the Act, in the operations "the special water economy, stand structure, old hold-over trees and dead and decaying trees shall be preserved and the vegetation, variability of the terrain and the soil type shall be taken into account. Action that may not be taken in habitats of special importance includes regeneration felling, forest road construction, treatment of soil surface that may damage vegetation characteristic to the site, ditch drainage, clearing of brooks and rivulets and use of chemical pesticides." Under section 10b of the Act, in immediate surroundings of small bodies of water and in mire habitats, "cautious fellings by picking individual trees may be undertaken provided that this preserves the stand in its natural or semi-natural state in a way that the natural or semi-natural water economy of the habitat does not change". If complying with the felling restrictions causes financial loss or harm which is not minimal, the landowner may, however, apply for a derogation under certain conditions (section 11 of the Act).

Guidelines on the use of peatland forests are also provided through forest management recommendations (Äijälä et al. 2014; Kaukonen et al. 2018) and forest certification (FSC Finland 2011; PEFC Finland 2014). For example, the Metsähallitus Environmental Guidelines for Forestry (Kaukonen et al. 2018) contain several recommendations on safeguarding undrained mire habitats. It is recommended that, among habitat types determined as threatened in the previous threat status assessment of habitat types (Raunio et al. 2008), mires that are in their natural or semi-natural state in terms of water economy and tree stands, as well as undrained mires on poorly productive forest land and unproductive land, should be excluded from forestry operations. The safeguarding of spruce mires is also emphasised. The Criteria for PEFC Forest Certification (PEFC Finland 2014), which are used the most extensively in Finland, mainly recommend to avoid the drainage of certain mire habitats (natural-state and deadwood-rich spruce mires, rich pine fens, wooded swamps, natural-state mire habitat types classified as Critically Endangered (CR) and Endangered (EN) in Southern and Northern Finland in the 2008 assessment of threatened habitat types in Finland) but may allow, for example, intermediate felling and removal of individual trees.

The Forest Act reform permitted the cultivation of uneven-aged forests maintained by selective cutting as a forestry method. This provides the opportunity to also develop mire forest management towards improved consideration for diversity values. For example, clear cutting of spruce mires and related mechanical soil manipulation alter the habitat type so strongly that such occurrences were interpreted as collapsed in this assessment. Methods of continuous-cover management and opportunities for their application to mire forests are currently being researched (Laiho 2016).

Despite legislation and forest management recommendations, especially undrained spruce mires, thin-peated pine mires and spruce-pine mires are still used for forestry, which may deteriorate their quality. Safeguarding small occurrences in particular in conjunction with forestry measures is challenging. Even if no forestry measures are targeted at the safeguarded mire site itself, felling and mechanical soil manipulation taking place at the edge of the forest compartment and in adjacent areas may affect its hydrology and microclimate.

Agricultural use of mires

Clearing for agriculture has been one of the most significant factors altering mire habitat types especially in southern and western Finland. Agricultural use has focused particularly on eutrophic mires and herb-rich spruce mires, but a large number of other nutrient-rich mire types have also been cleared for farming use. Many lagg areas of southern raised bogs and minerotrophic mires in the raised bog area lost their natural state a long time ago. Ombro- and oligotrophic mires and bogs with *Sphagnum fuscum* also used to be cleared and burned before cultivation particularly in western Finland even though they were less suitable for use as arable land. After the Second World War, tens of thousands of hectares of crop fields were cleared in the rich fen areas of eastern and northern Finland.

Different sources provide very different estimates of the areas used for peatland agriculture. It has generally been estimated that around 0.7–1.0 million hectares of mires have been cleared for agriculture (Myllys and Sinkkonen 2004; Vasander 2006). Around 262,000 hectares of peatland fields are currently in active use (Soil class database 2018). The ecological recovery of peatland fields no longer in agricultural use is likely to be slow and uncertain, and there is no relevant research data available. There was an upturn in the clearing of peatland fields in the early 2000s and, by 2013, a total of 37,000 hectares of new peatland fields had been cleared (Regina 2015). Such clearing has taken place particularly in North Ostrobothnia, South Ostrobothnia, Ostrobothnia and North Savo (Niskanen and Lehtonen 2014). Clearing for agriculture has been assessed as still posing a significant future threat, particularly in areas on which livestock farming focuses, because additional field capacity is required for spreading manure.

Unlike clearing for crop farming, mowing and grazing related to livestock farming did not destroy the mire ecosystem. A significant proportion of Finnish mires, especially fens and rich fens, have been grazed and mowed at some point (Linkola 1995; Pykälä 2001; Vainio et al. 2001). Use of mires for mowing and grazing commonly also involved human-induced flooding by dams, particularly in Northern Finland. Trees and shrubs were also often cleared. Today, the remaining grazed or mowed peatland meadows cover just over 200 hectares (Lehtomaa et al. 2018). Mowing and grazing appear to have had a major impact on Finland's mire habitats and the abundance ratios of mire species, but their impacts on the various mire types are not sufficiently known. Reindeer grazing probably has a corresponding openness-maintaining impact on mire habitats as livestock grazing used to have, but there is hardly any research data on this (Blind et al. 2015).

Mowing and grazing have had a positive impact on the diversity of mire vegetation as increased openness and breaking of moss cover have enabled the success of mire species that are weaker competitors, too. The **discontinuation of traditional mowing and grazing** has resulted in overgrowth, particularly in Southern Finland's remaining small-sized rich fens, especially rich lawn fens, as well as rich spruce-birch fens and rich pine fens (Heikkilä 1992; Heikkilä 1998; Pykälä 2001). Overgrowth has also been found in Northern Finland's rich fens following the discontinuation of mowing (Kulmala 2005).

Overgrowth and changes in species composition will continue to pose a particularly high threat to small-sized rich fens in Southern Finland in the future, too. The trend may in part also be natural or be caused by factors such as hydrology disturbances. The discontinuation of traditional mowing and grazing is a contributing factor to the threat of overgrowth faced by open swamps, too, but this overgrowth is also affected by other factors such as drying caused by hydrology disturbances, and the general eutrophication trend.

Peat extraction

Before the 1950s, the use of peat mainly comprised local small-scale household use. Extracting peat for livestock bedding use had hardly any impact on mire hydrology and in part it even created thinner-peat patches where more demanding plant species found sites to grow. Industrial peat extraction reached the current scale after the onset of the 1970s energy crisis. In addition to use for energy production, peat is also extracted for horticultural and environmental use. Peat extraction has mainly had local impacts on mire habitats, but in certain areas (such as Ostrobothnia, Figure 4.34) the impacts have been greater. The zone that is most suitable for fuel peat production is located in central parts of Finland in North Satakunta, Ostrobothnia and North Karelia, but there are also areas suitable for peat extraction elsewhere in the country (Virtanen et al. 2003). The raised bogs of southwestern Finland are the best mires for horticultural peat. Peat extraction has focused particularly on large mires with a thick layer of peat. Peat extraction is assessed as having had the greatest impact on Southern Finland's raised bogs and middle boreal aapa mires. The mire types affected the most by it are ombro- and oligotrophic pine mires and bogs, pine fens and fens.

More than 100,000 hectares of mires have been used for peat extraction (MI3 Peat production, 16 September 2013). According to an estimate by VTT Technical Research Centre of Finland, the peat production area required in 2020 is around 57,000 hectares, of which 33,000 hectares comprises new production sites (Flyktman 2012). The area needed for the production of environmental and horticultural peat in 2020 is estimated to be around 10,800 hectares, with new production sites accounting for more than 8,400 hectares of this. According to the VTT estimate, the area required for peat production in the 2020–2050 period totals 100,000 hectares (Flyktman 2012). According to calculations by the Geological Survey of Finland (GTK), Finland's technically usable peatland area totals 1.2 million hectares (Virtanen et al. 2003). The technically usable area does not take into account permit restrictions relating to nature conservation and environmental protection or issues related to economic viability.

Policies concerning the energy use of peat have varied recently from one government term in office to another. The policy of Prime Minister Katainen's Government was to systematically reduce the energy use of peat so as to cut it by a third by 2025 (Ministry of Employment and the Economy 2013). The National Energy and Climate Strategy for 2030 updated by Prime Minister Sipilä's Government does not set any reduction targets for peat use (Huttunen 2017). Finland's Energy and Climate Roadmap 2050 serves as a longer-term strategic-level guide on the journey towards a carbon-neutral Finland (Parliamentary Committee on Energy and Climate Issues 2014). It did not set any targets for the reduced energy use of peat, either.

Improvements have been introduced in recent years in the targeting of peat extraction. The Government resolution on the sustainable and responsible use and conservation of mires and peatlands outlines the policy that any activities that significantly alter mires are to be targeted at mires which have already been drained or whose natural state has otherwise been significantly altered (Government 2012). The resolution also provides a scale for naturalness to facilitate the general planning of mire and peatland land use. The starting point of the guidelines of the Ministry of the Environment on taking mires and peatlands into account in regional land use plans is that mires in naturalness categories 0 and 1

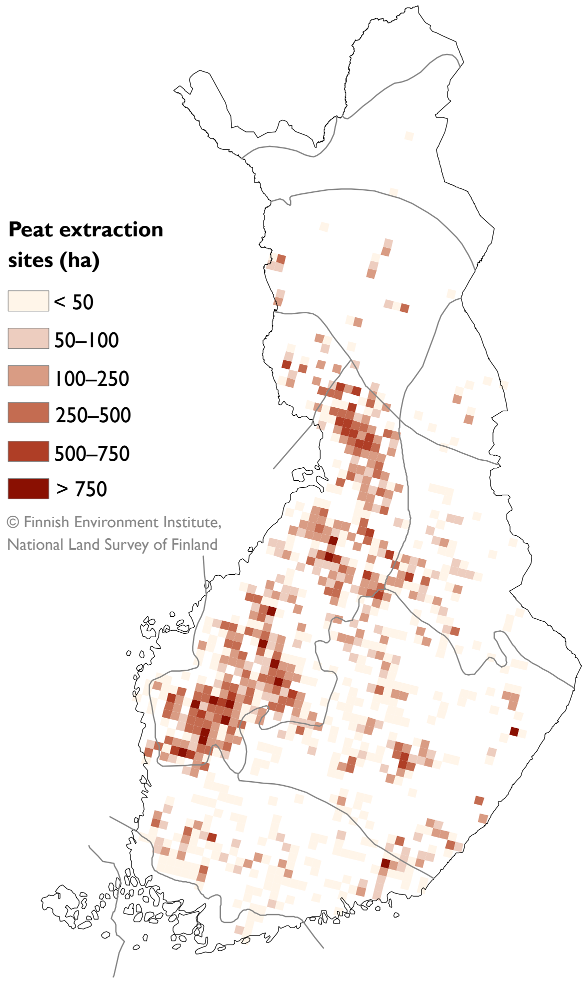

Figure 4.34.Total area of peat extraction sites in Finland in the EEA 10 x 10 km^2 reference grid (EEA reference grid 2018). Initial data: Corine Land Cover 2012 data (Corine Land Cover 2012).

and, only under certain conditions, mires in naturalness category 2 are allocated for peat extraction (Ministry of the Environment 2015).

According to the reformed Environmental Protection Act (527/2014), "the siting of peat production shall not lead to the deterioration of nationally or regionally significant natural values. When assessing the significance of natural values, the threatened mire species and habitats found at the site, the importance and extent of the deposit, and the extent to which the mire is in a natural state shall be taken into account." Also under the Act, "---peat production may be located in mires where the natural state has been significantly altered due to trenching. When assessing the alteration to the natural state of a mire, alterations due to trenching in the water economy and flora shall be taken into account." Under the Government Decree on Environmental Protection (713/2014), an alteration of the natural state of a mire is significant if: 1) the hydrology of the mire has been irreversibly altered, the water level has been lowered and vegetation has been altered throughout the mire; 2) the hydrology has been altered throughout the mire, the water level has been lowered throughout the mire and the alterations in the mire vegetation are clear; or 3) the mire has drained and undrained parts, drainage prevents a hydrological connection between the mire and its surrounding environment and some drying and alterations in mire vegetation occur in part of the undrained area of the mire.

Peat extraction may still pose a threat to undrained mire sections of larger mire areas in particular. Peat extraction may still threaten especially southern concentric and eccentric raised bogs, *Sphagnum fuscum* raised bogs, middle boreal aapa mires and the southern subtype of northern boreal aapa mires (Peräpohjola region's aapa mires). The mire types facing a particular threat from peat extraction include fens, pine fens and pine mires and bogs located in centres of mire complexes.

Other reasons for becoming threatened and threat factors of mire habitat types

Various types of **infrastructure construction** (such as residential and industrial areas, construction on the shoreline, road networks, etc.) are assessed to apply to a large proportion of mire habitat types as reasons for them becoming threatened or as threat factors, although for mire types in particular usually by a rather low degree of significance (Figure 4.29). Around 40,000 hectares of mires are estimated to have been lost due to construction (Vasander 1998; MI4 Other uses of peatlands, 7 May 2013). From the perspective of mire habitats, more relevant than the area covered by construction is the fact that construction and transport networks have fragmented previously uniform mire entities and therefore caused hydrological changes in mire complexes. Infrastructure construction will threaten to fragment remaining mire areas in the future, too.

Quantitative and qualitative changes in mire habitats have also been caused by **hydraulic construction** (such as reservoir construction, flood control, dredging, clearing, streambed straightening, structural alteration of littoral and riparian zones) and, in surface water influenced types located by water bodies, also by **water body regulation** preventing the natural flood cycle. Around 60,000 hectares of mires, especially aapa mires, have been submerged under reservoirs in Northern Finland and Ostrobothnia. Clearing and straightening of streams has had adverse effects on mires located by streams, such as wooded swamps and herb-rich spruce mires. In the future, hydraulic construction and water body regulation may pose a threat for swamps and other mire types with surface water influence occurring by water bodies.

In some places the **abstraction of groundwater** has lowered the water level of surrounding mires and at times the impacts may even reach areas further away. Mires most sensitive to such impacts include those requiring the groundwater influence, such as, aapa mire margins with a groundwater effect, mire types with groundwater influence (such as rich spring fens, rich birch fens) and Southern Finland's small-sized rich fens. In the future, too, groundwater abstraction may continue to cause local declines in mire hydrology.

In Northern Finland, **off-road vehicle use** relating to activities such as tourism and reindeer husbandry has created local wheel tracks and other mechanical wear and this threat may grow in the future. In Southern Finland, too, off-road motor vehicle use has in places caused permanent damage to mires. **Reindeer grazing** has reduced the amount of lichens in frost bogs and mires, especially in palsa mires. Grazing may also cause palsa mound erosion and speed up the thawing of palsas. Mires with herbs, sedges and grasses are spring and summer grazing areas for reindeer (Nieminen et al. 1998; Nyström et al. 2013; Blind et al. 2015), but this has not been regarded as posing a threat to mire habitat types.

The threat of **mining** is assessed as having increased, but the impact is still more local or regional. As regards mire complex types, the threat is assessed as mainly affecting the southern subtype of northern boreal aapa mires and local mire complexes. Mire types facing the threat include eutrophic mires in particular, most significantly rich birch fens and rich *Calliergon richardsonii* flark fens. Mining pressure is currently targeted most strongly at the Central Lapland Greenstone Belt whose bedrock contains many valuable metals (Mining Register 2018). The special characteristics of the bedrock are also reflected in mire vegetation, such as the vegetation of rich birch fens and rich flark fens.

In recent years, interest has emerged in Finland in utilising *Sphagnum* mosses for commercial purposes such as gardening substrate production. **The collection of *Sphagnum* mosses** has so far taken place on a trial basis but has raised high expectations, and other potential uses have also been explored (such as filter material, insulation, packaging material and raw material for bioactive compounds). A layer of 5–25 cm of *Sphagnum* moss would be machine-collected from the mire surface, and it has been estimated that collection could be repeated in around 30 years after the previous collection. In this assessment, moss collection has been assessed as a future threat for the mire complex types of concentric, eccentric and *Sphagnum fuscum* raised bogs as well as for middle boreal aapa mires and coastal mires. As regards mire types, it is mentioned as a future threat for seven assessed mire types, which mainly represent ombro- and oligotrophic lawn-level fens, pine fens and pine mires and bogs. The significance of the threat has so far been assessed as local and rather low, but it is currently difficult to anticipate its future significance. The extent of the threat will depend of the scope of the activities, on their siting in mire areas and on whether or not the activities will be regulated. At the moment *Sphagnum* collection does not require any advance permit or notification procedure under environmental legislation.

Eutrophying deposition has been identified as a reason for habitat types becoming threatened and/or as a threat for ombrotrophic mire types (ridge-hollow pine bogs, ombrotrophic low-sedge bogs, hollow bogs) and for four raised bog mire complex types (plateau and heath raised bogs, concentric raised bogs, eccentric raised bogs and *Sphagnum fuscum* raised bogs). Its significance has been assessed as rather low. The assessment is, however, made difficult by the fact that there is no research data on the direct impacts of nutrient deposition on Finnish mire habitats. On the other hand, there are observations of increases in tree stands in natural raised bogs in areas such as Southern Sweden and Denmark (Ihse et al. 1992; 1996; Åberg 1992; Aaby 1994; Gunnarsson et al. 2002). An increase in tree stands has also been observed in an undrained concentric raised bog in Finland (Tuominen and Aapala 2001).

4.4.5 Comparison with previous assessment

This second threat status assessment applied the IUCN methodology (IUCN 2015) whereas a national method was used in the first Finnish assessment (Raunio et al. 2008). The methods differ from each other to such an extent that the results of this assessment are not directly comparable with the results of the previous assessment.

Habitat type level

At the nationwide level (Figure 4.35), the IUCN Red List category of 22 mire habitat types remained unchanged from the previous assessment (Kaakinen et al. 2008). In this assessment, 17 habitat types were uplisted and 5 were downlisted. Compared with the previous assessment, there were 6 new habitat types assessed: the frost bog and mire subtypes of palsa bogs and pounikkos, the rich pine fen subtypes of mire margin influenced rich pine fens and rich pine fens with *Sphagnum fuscum*, calcareous fens and rich *Calliergon richardsonii* flark fens.

The most significant reason for uplisting or downlisting from the previous assessment is the change in method – either alone or combined with other reasons (Table 4.4). Therefore any downlisting to a lower category must not be interpreted straightforwardly as a reduction in the risk of collapse of the habitat type and, correspondingly, any uplisting must not be interpreted as an increase in the risk of collapse compared with the previous assessment.

A genuine change in threat status was assessed as being at least a partial reason for the uplisting of thin-peated pine mires and thin-peated spruce mires as well as *Vaccinium* spruce mires. Increased felling pressure in particular was regarded as the reason for this. Likewise, the threat status of rich flark fens and, in the subregional assessment for Southern Finland, also that of flark fens was interpreted as having increased, because drying resulting from hydrological disturbances caused by surrounding ditch drainage and other land use was assessed as having an impact on more extensive areas.

The reference period of the 50-year examination shifting from the 1950s to the 1960s reduces the habitat type reduction percentage in the assessments of quantitative change (criterion A). This shift of assessment period was identified as a partial reason for the downlisting of *Eriophorum vaginatum* birch fens in the assessments for the whole of Finland and for Southern Finland, and of low-sedge pine fens in the assessment for Northern Finland, and as the primary reason for the downlisting of ombrotrophic low-sedge bogs for Southern Finland.

Two habitat types assessed as being threatened in the previous assessment – birch swamps and rich swamp fens – ended up being classified as Data Deficient (DD) in this assessment owing to a shortage of quantitative as well as qualitative data. Knowledge of the occurrence and status of these habitat types has hardly improved compared with the previous assessment, and some of the data employed in 2008 is already out of date. Data on these types concerning issues including the extent of change in abiotic and biotic quality and occurrence was not regarded as sufficient to assess the relative severity of the change using the IUCN methodology.

Habitat complex type level

The IUCN Red List category of 8 of the assessed mire complex types remained the same (Figure 4.36; cf. Kaakinen et al. 2008). The category of 7 mire complex types changed: plateau and heath raised bogs, concentric raised bogs, the southern subtype of northern boreal aapa mires, and palsa mires were uplisted to a more critical category, while eccentric, wooded and *Sphagnum fuscum* raised bogs were downlisted from the 2008 assessment (Figure 4.36). The reason for reclassification was usually a change in method and/or increase in knowledge (Table 4.5). Not a single reclassification was regarded as reflecting a genuine change in the state of the habitat type.

Three new habitat types were described and assessed among mire habitat complex types: southern fen complexes, coastal mires and succession series of small mires on the land uplift coast. Classified as Data Deficient (DD) in the previous assessment, local mire complexes were also assessed now.

National method 2008

IUCN method 2018	LC	NT	VU	EN	CR	DD	NE
LC	8	1					
NT	5	3	1				1
VU	1	3	6	2			2
EN			6	3	1		1
CR					1		1
DD		1		1		1	1

Figure 4.35. Red List categories of mire habitat types for the whole of Finland using IUCN methodology in 2018 and their classification based on the national method in 2008 (50 types, only the lowest hierarchical level included). The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassification. Figures in the NE column refer to new habitat types that were separated only in the second assessment in 2018.

National method 2008

IUCN method 2018	LC	NT	VU	EN	CR	DD	NE
LC	4						
NT	1		2				
VU		3	1	1		1	
EN				1			2
CR					2		1
DD							

Figure 4.36. Red List categories of mire habitat complex types for the whole of Finland using IUCN methodology in 2018 and their classification based on the national method in 2008 (19 types). The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassification. Figures in the NE column refer to new habitat types that were separated only in the second assessment in 2018.

Fact Box 4.2

Rauno Ruuhijarvi

Potential impacts of climate change on mire vegetation

Temperature and precipitation conditions will change

Finland's mean temperature has risen by around 2.3 °C since the pre-industrial era (Climate Guide 2018). This rate of increase has been 1.5–2 times that seen on average at the global scale (Ruosteenoja et al. 2016). The warming has mainly taken place in winter. Year-to-year variation is, however, high. There are many climate factors where no clear trends of change have been observed. The number of hot days and the length of dry periods in the summer is greater in coastal areas than in eastern Finland and Lapland.

From among the numerous global scenarios for greenhouse gas emissions, the one selected for use here is the cautious Representative Concentration Pathway (RCP) 4.5 (Ruosteenoja et al. 2016) where the emissions first increase slightly but then take a downturn around 2040. The lower scenarios are no longer possible. According to the projection, the mean temperature increase will reach 3–4 °C towards the end of the century, which is when the thermal conditions of central Finland will resemble the current climate of Poland. This means the temperature sum of the growing season (>+5 °C) in the south boreal zone would be 400–500 degree days higher than today. An equal increase would be seen in the middle boreal and north boreal zones (Ruosteenoja et al. 2016). Southern Finland's raised bog area would gradually turn hemiboreal in terms of its thermal conditions, the area of middle boreal aapa mires would become south boreal and that of north boreal aapa mires middle boreal. The calculation is not, however, this simple as day degrees accumulate late in the autumn when only some plants continue to grow. Mire plants belonging to this group comprise *Sphagnum* spp. mosses (Lindholm 1979). Peat is formed while at the same time decomposition increases.

Preservation of moisture conditions is of key importance to mires. Climate models project increasing precipitation rates for Finland. So far, this is not reflected in the long-term averages. According to the RCP4.5 scenario, precipitation would increase by around 10–20% from the current rate in all seasons by the end of the century. The rising temperature means some of the present precipitation received as snow will be rain. Southern Finland's precipitation rate will probably remain unchanged or at most increase slightly in the summer, but the decisive factor will be the rate of evaporation. Dry periods during hot summers are likely to become longer. In northern Finland precipitation rates will increase, especially in the winter.

Hydrological changes of mires will favour new vegetation

In the current south boreal mire vegetation zone, the most dominant mire moisture level is the hummock, in the middle boreal zone the lawn and in the north boreal zone the flark. The likely trend in the new climate is for hummocks to dry and expand further. Signs of change can already be seen by com-

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

paring aerial photographs. A shift in the same direction may also be caused by forestry drainage and nitrogen deposition via rainfall onto mires. Over the long term spanning centuries, it is possible that the plateau raised bog type of the Baltic Sea environment will spread throughout southern Finland. For large mires this would mean plateau raised bogs perhaps similar to Munasuo, Pyhtää, which is open in the middle but has rather steep peripheral slopes and well-developed laggs. A model for this could perhaps be found in the classic raised bog of Augstumal described by C. A. Weber (1902), which is located in southern Lithuania (Couwenberg and Joosten 2002). It is characterised by *Sphagnum medium* (before *S. magellanicum*) and *S. rubellum*. This would mean southern Finnish raised bog succession reverting back to the beginning – to the turn of the Atlantic and Subboreal periods. Even the species still exist in Finland, with only *S. fuscum* no longer able to compete against the red bog mosses. Smaller mires would be represented by heath raised bogs dominated by heather (*Calluna vulgaris*) or wooded raised bogs dominated by marsh Labrador tea (*Rhododendron tomentosum*) with their dense Scots pine (*Pinus sylvestris*) stands. There are already a few examples of a different raised bog "cake" forming on top of an old concentric raised bog (for example, Isosuo in Klaukkala, Vihti, and Torronsuo in Tammela). Drainage for forestry already has such a large impact on the wooded mire types of the peripheral parts that it is difficult to see the impacts of climate change. Climatic conditions would also enable the occurrence of southern fen complexes in the way seen in the Baltic States and Poland, but their other prerequisites – nutrient-rich, uncultivated soil and access of runoff water to undrained mires – can only be found in few areas in southern Finland.

The dominant mire complex types in middle boreal Finland are lawn-level aapa mires and, in addition to these particularly in coastal areas of the Bothnian Bay, eccentric raised bogs. The proportion of flarks is low. Over the past couple of millennia, the development trend of these mires has included the rapid spread of *Sphagnum papillosum* at the expense of flark; forest colonisation turning tall-sedge fens and low-sedge fens into pine fens and *Eriophorum vaginatum* pine bogs and mires; development of *Sphagnum fuscum* raised bogs and eccentric raised bogs in peripheral parts of mires; the coverage of hollows and flarks by *S. balticum*; and the drying of hummocks (Tolonen 1967). This trend appears to be continuing further and is being considerably boosted by the 60–80% rate of forestry drainage. The projected climate change with its dry periods and long autumns is promoting raised bog development in this area. The long-term outcome may be eccentric raised bogs similar to the present ones and *Sphagnum fuscum* raised bogs typical of southern Finland. In aapa mires, the surface moss layer may become ombrotrophic in a few decades as shown by Tahvanainen (2011) in North Karelia. In areas where mires remain minerotrophic thanks to groundwater, such as sloping fens, more and more wooded mire types will emerge. Rich fens and eutrophic influence in wet flarks will decline as *Sphagnum* spp. mosses take over.

North boreal aapa mires dominated by extensive wet flarks and a clear string structure maintained by intensive and long periods of spring flooding are less susceptible to changes. Increasing winter precipitation is also projected for the area. A regressive trend with pools and flarks carved by water prevails for northern aapa mires due to weak peat formation. The area has fewer pine mires and bogs as well as spruce mires than the more southern parts of Finland. Raised bogs often adjoin shores of rivers, streams and lakes as well as drainage divides. The lawn vegetation of rich fens and moderately rich fens is sensitive to climate change. The increase of *Sphagnum* spp. mosses, especially *S. riparium*, can already be observed in flark areas with groundwater influence. Most threatened are the rich birch fen habitats typical of the Central Lapland Greenstone Belt, where climate change may affect the water volumes and temperatures of flooded mires and mires with groundwater influence and, consequently, the growing conditions of mosses in particular.

In northern Peräpohjola, Forest Lapland and Fell Lapland, the thawing of ground frost is altering the growing conditions of hummocks and also the hydrology of mires. Ground frost in the strings of aapa mires and northern reticulate raised bogs prevents floodwater from spreading freely. When this impact is lost, the growing conditions of strings and pounikkos improve and the Scots pine (*Pinus sylvestris*) gains ground. The thawing of the frost cores of palsa mires has been taking place for decades now. The palsas of the southernmost palsa mires in Enontekiö and Inari have already been or are being lost, and thawing is extending to all mound palsa areas. The broader permafrost of plateau palsas appears to tolerate warming better, but these palsas are also already thawing in the birch zone. Perhaps around half of palsas have thawed so far, and researchers are quite unanimous as regards palsas disappearing by the end of the century (e.g. Fronzek 2013). No new palsas to replace the ones lost have been created in recent decades. Any frost lenses formed every now and then in flarks are short-lived. Other changes visible in palsa mires include increased water surfaces and the emergence of flarks with *Sphagnum* spp. mosses in place of thawed palsas. The visible change applies to a rather small proportion of the mire area, but its underlying factors, such as the lengthening of the growing season and the alteration of winter snow cover, may have potentially strong impacts on species. So far there are no observations of how extensive frost pounikkos are changing due to thawing. Over time, mire complexes will turn into aapa or fell mires, and the change will be relatively rapid.

Alternative trend

The climate scenario presented above is rather cautious, and the rate of global warming may also be more intense. There are, however, a large number of uncertainties relating to the projections. Researchers have drawn attention to the possibility that the climate of Northern Europe may change in a manner different from elsewhere in the world. There are increasing indications that the North Atlantic Current, which extends the Gulf Stream northeastward, has begun to weaken (e.g. Caesar et al. 2018). This is caused by the increasing melting of Greenland glaciers and Arctic sea ice. Fresh and cold surface water is pushing the tropical current towards the south from the North Atlantic and the surrounding sea is cooling – a phenomenon not seen in any other ocean in the world. More observations are, however, required, particularly from the coastal areas of Fennoscandia. The possibility of climate change slowing down does, however, exist in the northern impact area of the Gulf Stream.

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4.5

Forests

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Autiovaara, Patvinsuo National Park, Lieksa. Photo: Maarit Similä

4.5.1

Threat status, reasons for becoming threatened and threat factors of forest habitat types

Of the 40 examined forest habitat types, 15 are herb-rich forests, 19 heath forests[2] and 6 special forest habitats. Altogether 2 of the herb-rich forest habitat types and 4 of the heath forest habitat types are group-level types, which means 34 of the forest habitat type assessment units are at the lowest hierarchical level. The overall results of the assessment and the percentages of the threatened habitat types given below were calculated on the basis of assessment units at the lowest hierarchical level of the classification.

Among the forest habitat types assessed at the nationwide level (34 types), 76% were assessed as threatened (VU, EN or CR), 21% as Near Threatened (NT) and 3% as Data Deficient (DD) (Figure 4.37). The percentage of threatened habitat types is highest among heath forests in Southern Finland (Figure 4.38). Of the threatened habitat types, 9 were classified as Endangered (EN) and 17 as Vulnerable (VU). There was 1 habitat type – inland dune forests – assessed as DD. Of the Endangered (EN) habitat types, 2 are herb-rich forests (herb-rich forests with European white elm and mesic eutrophic herb-rich forests) and 7 are heath forests (old conifer-dominated herb-rich heath forests, old conifer-dominated mesic heath forests, young sub-xeric heath forests, old sub-xeric heath forests, young xeric heath forests, old xeric heath forests, and barren heath forests).

The percentage of threatened habitat types is clearly higher in Southern Finland than in Northern Finland (Table 4.6, Figure 4.37). In Southern Finland 79% and in Northern Finland 56% of the habitat types were assessed as threatened. Of the threatened habitat types of Southern Finland, 3 were classified as Critically Endangered (CR) – old sub-xeric heath forests as well as young and old xeric heath forests) – and 24 as Endangered (EN) or Vulnerable (VU).

In Northern Finland all of the 14 habitat types classified as threatened are Vulnerable (VU) or Endangered (EN) and all EN habitat types are heath forests. The percentage of Near Threatened (NT) habitat types is 32% in Northern Finland and 18% in Southern Finland. There were 2 habitat types classified as Least Concern (LC) in Northern Finland (mature conifer-dominated herb-rich heath forests and forests on rocky terrain) but 0 in Southern Finland. Inland dune forests was the only habitat type classified as Data Deficient (DD) in Southern as well in Northern Finland.

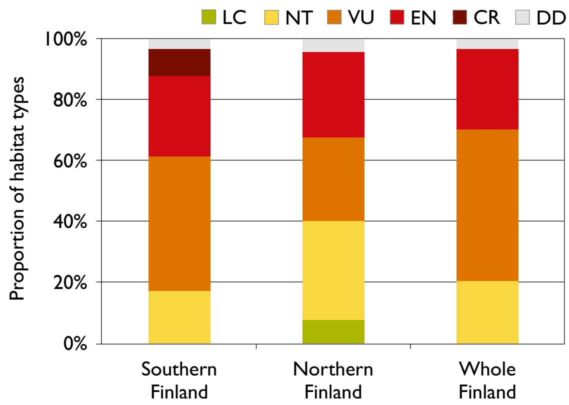

Figure 4.37. Breakdown of forest habitat types into IUCN Red List categories by percentage of number of habitat types at the lowest hierarchical level in Southern Finland (34 types), Northern Finland (25 types) and the whole of Finland (34 types).

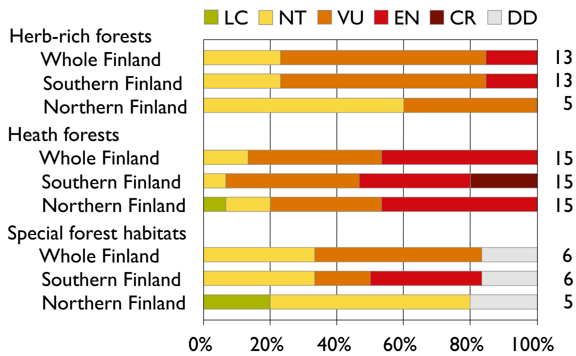

Figure 4.38. Breakdown of forest habitat types into IUCN Red List categories in the whole of Finland, Southern Finland and Northern Finland by main group of habitats (percentages of numbers of habitat types at the lowest level of hierarchy). Figures on the right show the numbers of assessed habitat types for each of the main groups in the given region.

1 By heath forests we mean 'taiga' forests growing on podsolic soils (the prevailing forests in the boreal zone), as opposed to herb-rich forests which have black soil or peatland forests growing on peat. 'Herb-rich heath forests' is the most fertile forest site type of heath forests.

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Table 4.6. Results of the threat status assessment of forest habitat types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
M	**Forests**									
M1	**Herb-rich forests**	F	VU		CD1	–	VU		AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, DR 1, FDS 1, CST 1, WHC 1, IAS 1, WBR 1, EXT 1, MW 1, GP 1	FTS 3, FCWD 2, FOG 2, F 1, IAS 1, DR 1, FDS 1, GP 1, CST 1, WBR 1, EXT 1 ,OTF 1, MW 1
		SF	VU		CD1	–	VU			
		NF	NT		CD1	=	NT			
M1.01	Herb-rich forests with deciduous (hardwood) trees	F	VU		A1	=	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, OTF 2, F 1, GP 1, CST 1, DR 1, FDS 1, IAS 1, MW 1, WBR 1, WHC 1	FTS 2, FCWD 2, FOG 2, OTF 2, GP 1, F 1, FDS 1, CST 1, IAS 1, DR 1, MW 1, WBR 1
		SF	VU		A1	=	EN	3		
		NF								
M1.01.01	Herb-rich forests with small-leaved lime	F	VU		A1	=	EN	3	AGCL 3, FTS 3, FOG 2, FCWD 2, F 1, GP 1, FDS 1, CST 1, IAS 1, OTF 1	FTS 2, FCWD 2, FOG 2, GP 1, F 1, FDS 1, CST 1, IAS 1, OTF 1
		SF	VU		A1	=	EN	3		
		NF								
M1.01.02	Herb-rich forests with hazel	F	VU		A1	=	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, FDS 1, GP 1, CST 1, MW 1, IAS 1	FTS 2, FCWD 2, FOG 2, GP 1, F 1, FDS 1, CST 1, IAS 1
		SF	VU		A1	=	EN	3		
		NF								
M1.01.03	Herb-rich forests with common oak	F	VU		A3	=	CR	3	AGCL 3, FTS 3, FCWD 2, FOG 2, GP 2, F 1, FDS 1, CST 1, OTF 1, MW 1	FTS 2, FCWD 2, FOG 2, GP 2, OTF 1, F 1, FDS 1, CST 1, MW 1, IAS 1
		SF	VU		A3	=	CR	3		
		NF								
M1.01.04	Herb-rich forests with common ash	F	VU		A1, B1a(i,iii)b	–	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, OTF 2, DR 2, F 1, FDS 1, GP 1, CST 1	OTF 3, FTS 2, FCWD 2, FOG 2, DR 2, GP 1, FDS 1, F 1, IAS 1, CST 1
		SF	VU		A1, B1a(i,iii)b	–	EN	3		
		NF								
M1.01.05	Herb-rich forests with Norway maple	F	NT		A1	=	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, GP 1, FDS 1, CST 1, MW 1	FTS 2, FCWD 2, FOG 2, F 1, MW 1, GP 1, FDS 1, CST 1, IAS 1
		SF	NT		A1	=	EN	3		
		NF								
M1.01.06	Herb-rich forests with wych elm	F	VU		A1, B1,2a(i,ii)b	–	CR	3	AGCL 3, FTS 3, FCWD 2, FOG 2, OTF 2, F 1, GP 1, FDS 1, CST 1	OTF 3, FTS 2, FCWD 2, FOG 2, GP 1, F 1, FDS 1, IAS 1, CST 1
		SF	VU		A1, B1,2a(i,ii)b	–	CR	3		
		NF								
M1.01.07	Herb-rich forests with European white elm	F	EN		A1, B1,2a(i,ii,iii)bc	–	CR	3	AGCL 3, FTS 3, WBR 3, WHC 2, FCWD 2, FOG 2, OTF 2, DR 2, CST 1, F 1, FDS 1, GP 1, IAS 1	OTF 3, WBR 2, FTS 2, FCWD 2, FOG 2, IAS 1, FDS 1, F 1, GP 1, CST 1, RTF 1
		SF	EN		A1, B1,2a(i,ii,iii)bc	–	CR	3		
		NF								
M1.02	Herb-rich forests classified by moisture and nutrient content									
M1.02.01	Dry mesotrophic herb-rich forests[1]	F	NT		CD1,CD2a	–	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, EXT 2, F 1, FDS 1, CST 1, IAS 1, MW 1	FTS 3, FCWD 2, FOG 2, F 1, FDS 1, CST 1, IAS 1, EXT 1, GP 1
		SF	NT		CD1,CD2a	–	EN	3		
		NF	NT		CD1	=	VU	3		
M1.02.02	Dry eutrophic herb-rich forests[1]	F	VU		CD1	–	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, EXT 2, F 1, CST 1, FDS 1, IAS 1, GP 1, MW 1	FTS 3, FCWD 2, FOG 2, F 1, FDS 1, CST 1, IAS 1, GP 1, EXT 1
		SF	VU		CD1	–	EN	3		
		NF	NE				EN	5		
M1.02.03	Mesic mesotrophic herb-rich forests	F	VU		CD1	–	VU		AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, DR 1, FDS 1, CST 1, IAS 1, MW 1, EXT 1	FTS 3, FCWD 2, FOG 2, F 1, IAS 1, FDS 1, CST 1, GP 1
		SF	VU		CD1	–	VU			
		NF	NT		CD1	=	NT			
M1.02.04	Mesic eutrophic herb-rich forests	F	EN		CD1	–	CR	3	AGCL 3, FTS 3, FCWD 2, FOG 2, GP 2, F 1, DR 1, FDS 1, CST 1, IAS 1, MW 1, EXT 1	FTS 3, FCWD 2, FOG 2, GP 2, F 1, IAS 1, FDS 1, CST 1, OTF 1, EXT 1
		SF	EN		CD1	–	CR	3		
		NF	VU		CD1	=	VU			
M1.02.05	Moist mesotrophic herb-rich forests	F	NT		CD1,CD2a	–	NT		AGCL 3, FTS 3, DR 3, FCWD 2, FOG 2, F 1, WHC 1, WBR 1, FDS 1, CST 1, IAS 1	FTS 3, DR 2, FCWD 2, FOG 2, F 1, IAS 1, FDS 1, GP 1, WBR 1, CST 1
		SF	NT		CD1,CD2a	–	NT			
		NF	NT		CD1	=	LC	3		
M1.02.06	Moist eutrophic herb-rich forests	F	VU		CD1	–	VU		AGCL 3, FTS 3, DR 3, FCWD 2, FOG 2, F 1, WHC 1, WBR 1, FDS 1, CST 1, IAS 1	FTS 3, DR 2, FCWD 2, FOG 2, GP 2, F 1, IAS 1, WBR 1, FDS 1, OTF 1, CST 1
		SF	VU		CD1	–	VU			
		NF	VU		CD1	=	NT	3		

[1]Dry mesotrophic and eutrophic herb-rich forests have been assessed as one assessment unit in Northern Finland and their results are included in the results of dry mesotrophic herb-rich forests.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
M2	**Heath forests**									
M2.01	Herb-rich heath forest	F	VU		D3	+	NT	3	FOG 2	FCWD 3, FTS 2, FDS 2, FOG 2, F 1, GP 1, CC 1
		SF	VU		D3	+	NT	3		
		NF	NT		A1	–	NT			
M2.01.01	Young herb-rich heath forests	F	VU		D3	+	VU		FDS 3, FCWD 3, F 2	FDS 3, FCWD 3, FTS 2, FOG 2, F 2, GP 1, CC 1
		SF	VU		D3	+	VU			
		NF	VU		D3	=	EN	3		
M2.01.02	Mature conifer-dominated herb-rich heath forests	F	NT		D3	+	NT		FCWD 3	FCWD 3, FTS 2, FOG 2, F 1, GP 1, CC 1
		SF	NT		D3	+	NT			
		NF	LC			=	VU–EN	5, 3		
M2.01.03	Old conifer-dominated herb-rich heath forests	F	EN		A3	+	NT–EN	5, 3	FOG 3	FOG 3, FCWD 2, GP 1, CC 1
		SF	EN		A3	+	NT–VU	5, 3		
		NF	EN		A1, A3	–	NT–CR	5, 3		
M2.02	Mesic heath forests	F	VU		D3	=	NT	3	FCWD 3, FDS 2, FOG 2, F 1	FCWD 3, FDS 2, FTS 2, FOG 2, F 1, GP 1, CC 1
		SF	VU		D3	=	NT	3		
		NF	NT		D3	=	NT			
M2.02.01	Young mesic heath forests	F	VU		D3	=	VU		FDS 3, FCWD 3, FTS 3, F 2, GP 1	FDS 3, FCWD 3, FTS 3, FOG 2, F 2, GP 1, CC 1
		SF	VU		D3	=	VU			
		NF	VU		D3	–	VU			
M2.02.02	Mature conifer-dominated mesic heath forests	F	NT		D3	+	NT[2]		FCWD 3, F 1	FCWD 3, FTS 2, FOG 2, F 1, GP 1, CC 1
		SF	VU		D3	+	NT[2]	5, 3		
		NF	NT		D1, D3	–	LC–VU	5, 3		
M2.02.03	Old conifer-dominated mesic heath forests	F	EN		A3	–	LC–VU	5, 3	FOG 3	FOG 3, FCWD 2, GP 1, CC 1
		SF	EN		A3	=	LC–VU	5, 3		
		NF	EN		A3	–	LC–VU	5, 3		
M2.02.04	Mature deciduous-dominated herb-rich and mesic heath forests	F	VU		A1, D3	=	VU–EN	5, 3	FOG 2, FCWD 2, FDS 1, GP 1	FCWD 3, FOG 2, FDS 1, FTS 1, F 1, GP 1
		SF	VU		A1, D3	=	EN–CR	5, 3		
		NF	VU		D1, D3	–	LC–VU	5, 3		
M2.02.05	Old deciduous-dominated herb-rich and mesic heath forests	F	VU		A1, D1, D3	–	EN–CR	5, 3	FOG 3, FCWD 1, GP 1	FOG 3, FCWD 2, FTS 1, GP 1
		SF	VU		A1, D3	–	EN–CR	5, 3		
		NF	EN		A1	–	VU–CR	5, 3		
M2.03	Sub-xeric heath forests	F	EN		D3	–	NT	3	FCWD 3, FDS 2, FOG 2, F 1, ADE 1	FCWD 3, FDS 2, FTS 2, FOG 2, F 1, ADE 1, GP 1, CC 1
		SF	EN		D3	–	NT	3		
		NF	VU		D3	–	LC	3		
M2.03.01	Young sub-xeric heath forests	F	EN		D3	–	VU	3	FDS 3, FCWD 3, F 2, ADE 1	FDS 3, FCWD 3, FTS 3, FOG 2, F 2, ADE 1, GP 1, CC 1
		SF	EN		D3	–	VU	3		
		NF	VU		D3	–	NT	3		
M2.03.02	Mature sub-xeric heath forests	F	VU		D3	–	NT–EN	5, 3	FCWD 3, FOG 2, FDS 2, FTS 2, F 1, ADE 1	FCWD 3, FTS 2, FOG 2, FDS 2, F 1, ADE 1, GP 1, CC 1
		SF	EN		D3	–	NT–CR	5, 3		
		NF	NT		D1, D3	–	LC–EN	5, 3		
M2.03.03	Old sub-xeric heath forests	F	EN		A3	=	NT–CR	5, 3	FOG 3, ADE 1	FOG 3, FCWD 2, FDS 1, ADE 1, GP 1, CC 1
		SF	CR		A3	+	NT–CR	5, 3		
		NF	EN		A3	=	LC–CR	5, 3		
M2.04	Xeric heath forest	F	EN		D3	–	NT	3	FDS 3, FCWD 3, ADE 2, FOG 2, GP 1, F 1	FDS 3, FCWD 3, ADE 2, FOG 2, GP 2, FTS 1, F 1, CC 1
		SF	EN		D3	–	VU	3		
		NF	VU		A1, D1, D3	–	NT	3		
M2.04.01	Young xeric heath forests	F	EN		D1, D3	–	VU	3	FDS 3, FCWD 3, ADE 2, F 1, GP 1	FDS 3, FCWD 3, ADE 2, FOG 2, FTS 1, F 1, GP 1, CC 1
		SF	CR		D3	–	VU	3		
		NF	EN		D1	–	VU	3		
M2.04.02	Mature xeric heath forests	F	VU		D3	–	NT–EN	5, 3	FCWD 3, ADE 2, FOG 2, FDS 2, GP 1	FCWD 3, ADE 2, FOG 2, FDS 2, GP 2, FTS 1, CC 1
		SF	VU		D3	=	NT–EN	5, 3		
		NF	VU		D1	–	NT–EN	5, 3		
M2.04.03	Old xeric heath forests	F	EN		A3	+	NT–EN	5, 3	FOG 2, ADE 2, GP 1	FOG 2, ADE 2, FDS 2, GP 2, FCWD 1, CC 1
		SF	CR		A3	+	EN[2]	5, 3		
		NF	EN		A3	=	NT–EN	5, 3		
M2.05	Barren heath forests	F	EN		D3	–	CR	3	ADE 3, FDS 3, FCWD 3, FOG 2, GP 2	ADE 3, FDS 3, FCWD 3, FOG 2, GP 1, CC 1
		SF	EN		D3	–	CR	3		
		NF	EN		A1	–	CR	3		

[2]In 2008 the habitat type was divided into several assessment units that had the same Red List category.

Forests

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
M3	**Special forest habitats**									
M3.01	Sun-exposed esker forests	F	VU		CD3	–	VU		FDS 3, F 2, ADE 2, EXT 2, CST 2, FCWD 1	FDS 3, F 2, ADE 2, CST 2, EXT 2, FCWD 1
		SF	EN		CD3	–	EN			
		NF	NT	NT–VU	CD3	–	NT			
M3.02	Inland dune forests	F	DD		CD1–CD3	=	VU	3		FDS 2, ADE 2, FOG 1, EXT 1, GP 1, MW 1, FCWD 1, CST 1
		SF	DD		CD1–CD3	=	VU	3		
		NF	DD		CD1–CD3	=	NT	3		
M3.03	Inland flooded forests	F	VU	NT–EN	A3	–	EN	3	WHC 3, WBR 3, AGCL 2, DR 2, FTS 2, FOG 1	WHC 3, WBR 3, DR 2, FTS 2, FOG 1, CC 1
		SF	EN	VU–CR	A3	–	CR	3		
		NF	NT	NT–EN	A3	–	NT			
M3.04	Forests on rocky terrain	F	NT		D3	=	LC	3, 5	FOG 1, GP 1, FTS 1, FCWD 1, ADE 1	FOG 1, GP 1, FTS 1, FCWD 1, ADE 1, EXT 1, CST 1, MW 1
		SF	NT		D3	=	LC	3, 5		
		NF	LC			=	NT	3, 5		
M3.05	Forests on ultrabasic soils	F	NT	LC–VU	B2b	=	VU	3	EXT 1, F 1	EXT 1, F 1
		SF	NT	LC–EN	B1,2b	=	VU	3		
		NF	NT	LC–EN	B1,2b	=	NT			
M3.06	Heath forests with deciduous (hardwood) trees	F	VU	VU–EN	A1, CD1	=	VU		FTS 3, AGCL 2, FOG 2, FCWD 2, GP 1, OTF 1, F 1, DR 1, CST 1	FTS 3, GP 2, FCWD 2, FOG 2, OTF 2, F 1, DR 1, IAS 1, CST 1
		SF	VU	VU–EN	A1, CD1	=	VU			
		NF								

All but two of the criteria of the IUCN methodology were applied to the threat status assessment of forest habitat types at the nationwide level. The two criteria not used were the trend for habitat type quantity and quality over the period of 50 years including both past changes and potential changes in the future (criteria A2b and C/D2b), and the quantitative risk analysis of the probability of collapse (criterion E) (Figure 4.39). More than 80% of the forest habitat types were assessed as regards their quantitative development over the past or future 50 years (criteria A1 and A2a), their restricted geographic distribution and their continuing decline (criteria B1–B3), as well as their qualitative development over the past 50 years and over the historical time frame (criteria C/D1 and C/D3). However, a fairly large proportion of the assessments concerning the quantity and quality of habitat types as regards both the future and the historical time frame (since 1750) (criteria A2a, C/D2a, A3 and C/D3) resulted in classification as Data Deficient (DD) (Figure 4.39).

Quantitative change in the distribution of habitat types over the past 50 years (A1) was assessed for all forest habitat types excluding young succession stages of heath forests, and flooded forests. This criterion provided the grounds for forest habitat types with deciduous (hardwood) trees[2] in particular being classified as threatened. As regards quantitative changes over the next 50 years (A2a), all of the assessed habitat types were classified as Least Concern (LC) or Data Deficient (DD). The criterion was not applied (Not Evaluated, NE) to the assessment of heath forests at the site type level or of young succession stages. Quantitative changes in habitat types since 1750 (A3) resulted in the classification of almost all old succession stages of heath forests as Endangered (EN) and herb-rich forests with common oak and flooded forests as Vulnerable (VU).

Most forest habitat types are so extensive geographically that they were mainly classified as Least Concern (LC) on the basis of the B criteria (restricted geographic distribution and decline or very few occurrence sites). Only herb-rich forests with common ash, European white elm and wych elm (Scots elm) are threatened (VU, EN) and forests on ultrabasic soils Near Threatened (NT) on the basis of criterion B1 or B2.

Qualitative changes in the habitat type over the past 50 years (C/D1) corresponded to the Least Concern (LC) category for around a quarter of the forest habitat types at the nationwide level (when also taking into account Data Deficient (DD) ones). More than half of heath forests ended up classified as Near Threatened (NT). A third of herb-rich forests were classified as Vulnerable (VU), and 40% as Least Concern (LC). Qualitative changes over the

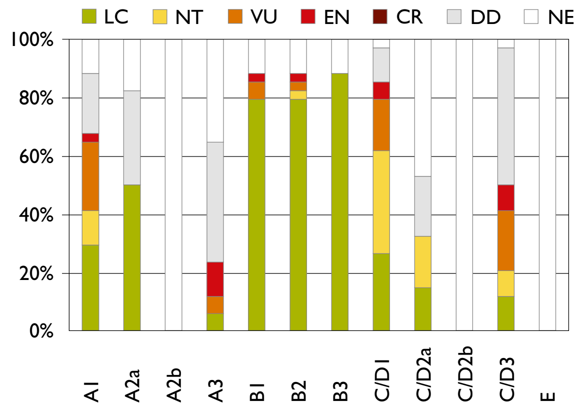

Figure 4.39. Forest habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria for the whole of Finland. The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. The figure only includes assessment units at the lowest hierarchical level of the classification (34 types). Assessment of total quality (CD) combining abiotic (C) and biotic (D) quality was used for herb-rich forests and most of the special forest habitats. For heath forests and forests on rocky terrain, changes in biotic (D) quality were assessed.

[2] Norway maple (*Acer platanoides*), hazel (*Corylus avellana*), common ash (*Fraxinus excelsior*), common oak (*Quercus robur*), small-leaved lime (*Tilia cordata*), wych elm (*Ulmus glabra*), European white elm (*Ulmus laevis*).

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

next 50 years (C/D2a) were assessed for only around half of the habitat types. Assessed as threatened on the basis of quality deterioration over the historical time frame (C/D3) were 9 heath forest types as well as sun-exposed esker forests. All herb-rich forest types ended up being classified on the basis of this criterion as Data Deficient (DD) (Figure 4.39).

Reasons for becoming threatened and threat factors

The most significant reasons for forest habitat types becoming threatened are a reduction in coarse woody debris (deadwood) (FCWD), reduction in old-growth forests and individual old trees (FOG) as well as changes in tree species composition (FTS). The reduced availability of deadwood is one of the reasons for 27 habitat types (79%) becoming threatened and, among these, its significance was assessed as high for 9 and rather high for 15 types. A reduction in old-growth forests and individual old trees was assessed as one of the reasons for almost as many, that is 25, habitat types (74%) becoming threatened and, among these, its significance is high for 4 and rather high for 19 types. Changes in tree species composition was one of the reasons for 18 habitat types (53%) becoming threatened and, among these, its significance was assessed as high for 15 types. The next most common reason for forest habitat types becoming threatened is clearing for agriculture (AGCL), which is of high significance for 13 and of rather high significance for 2 habitat types (Figure 4.40).

Other rather common yet mostly less significant reasons for the threat status of forest habitat types are a reduction in natural large-scale disturbances and lack of natural succession (FDS); mechanical soil manipulation (F), mammal herbivory on deciduous tree saplings (GP) and construction (CST). Of these, however, the first one was regarded as highly significant for 6 habitat types. Other reasons mentioned are atmospheric deposition of eutrophying substances (ADE), drainage for forestry (DR), reduced genetic diversity of deciduous (hardwood) trees (OTF: other reason), invasive alien species (IAS), mining activities (EXT), mechanical wear (MW), water level regulation (WBR) and hydraulic construction (WHC) (Figure 4.40).

The threat factors are mainly the same as the reasons for habitat types becoming threatened. The three most significant reasons for forest habitat types becoming threatened – a reduction in coarse woody debris (deadwood) (FCWD), reduction in old-growth forests and individual old trees (FOG) as well as changes in tree species composition (FTS) – are also the most important threat factors (Figure 4.40). Clearing for agriculture (AGCL) was assessed as no longer posing a threat to forest habitat types, whereas climate change (CC) was assessed as threatening 14 habitat types and so was the increasing risk of diseases and pests (OTF), which poses a threat to deciduous (hardwood) trees in particular. Mammal herbivory on deciduous tree saplings (GP) was also assessed higher as a threat than as a reason for habitat types becoming threatened (Figure 4.40).

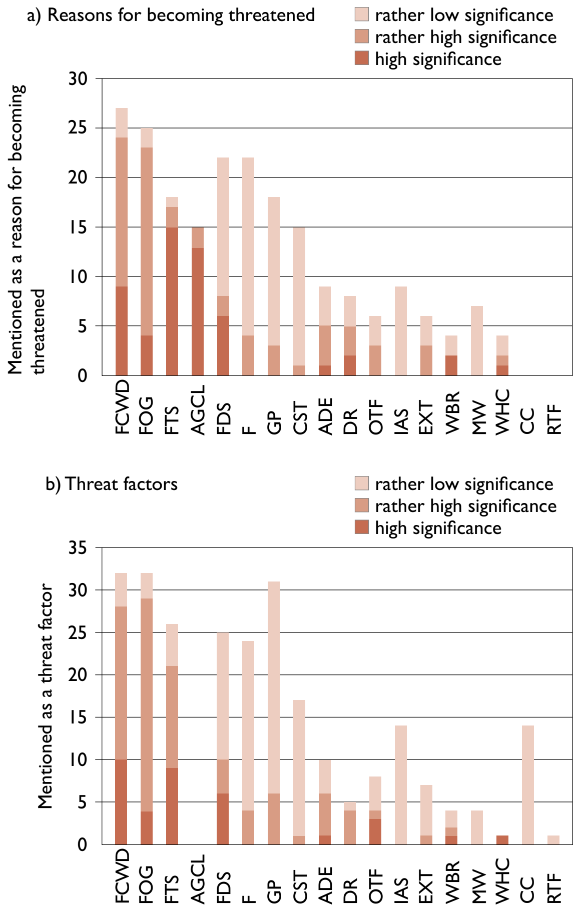

Figure 4.40. Reasons for becoming threatened (a) and threat factors (b) of forest habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

4.5.2
Herb-rich forests

All herb-rich forest types (13) and their group levels (2) were assessed. Dry herb-rich forests were assessed for Northern Finland as one entity and were not classified by nutrient content. No herb-rich forests with deciduous (hardwood) trees were assessed for Northern Finland. Because 96% of herb-rich forests in terms of their geographic area are located in Southern Finland (National Forest Inventory NFI11), the nationwide assessment is consistent with the assessment of Southern Finland.

A total of 77% of the assessment units at the lowest hierarchical level for herb-rich forests are threatened (VU–EN) in Southern Finland (and nationwide). Altogether 3 habitat types (herb-rich forests with Norway maple, dry mesotrophic herb-rich forests and moist mesotrophic herb-rich forests) were classified as Near Threatened (NT). There were no herb-rich forest

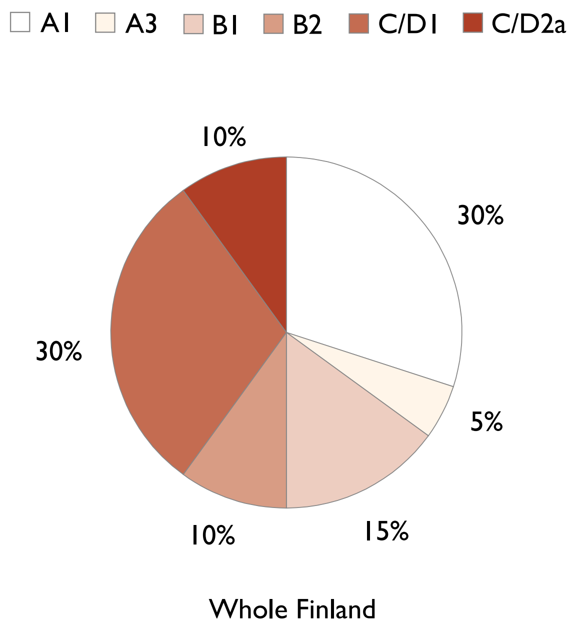

Figure 4.41. Decisive criteria determining the overall threat status for threatened and Near Threatened (NT) herb-rich forest habitat types in the whole country and in Southern Finland. For some habitat types, the final IUCN Red List category was determined on the basis of more than one criterion. All of these criteria are included in the figure. The figure only includes assessment units (habitat types) at the lowest hierarchical level of the classification. For Northern Finland, the decisive criterion for the overall threat status of all threatened and NT herb-rich forest habitat types was criterion CD1.

types in any examined region classified as Least Concern (LC) or Critically Endangered (CR) (Figure 4.38).

In Northern Finland, herb-rich forests are not as threatened as in Southern Finland (Figure 4.38), which is likely to be due to their protected status; according to NFI11, the percentage of protected herb-rich forests in Northern Finland (24%) is considerably higher than in Southern Finland (3%). In Northern Finland, Vulnerable (VU) habitat types only comprise moist eutrophic herb-rich forests and mesic eutrophic herb-rich forests, while the other types are Near Threatened (NT). Eutrophic herb-rich forest habitat types are more threatened than the mesotrophic types in all of the examined regions. For example, Finland's most common herb-rich forest type – mesic mesotrophic herb-rich forests – is Vulnerable (VU) in Southern Finland but mesic eutrophic herb-rich forests are Endangered (EN).

The most common decisive criterion determining the IUCN Red List category of herb-rich forest habitat types is changes in the habitat type's overall quality or quantity over the past 50 years (criteria C/D1 and A1; Figure 4.41). Restricted geographic distribution coupled with the habitat type's decline (the B criteria), qualitative trend projected for the future (criterion C/D2a) and reduction in the habitat type over the historical time frame (since 1750) (criterion A3) were also decisive in determining the assignment of the final category for some herb-rich forest habitat types (Figure 4.41).

There is a clear difference between herb-rich forests with deciduous (hardwood) trees and other herb-rich forests as regards which criterion or criteria provided the grounds for the assignment of their Red List category (Figure 4.41). The Red List category of herb-rich forest habitat types classified by moisture and nutrient content was assigned on the basis of qualitative changes (CD1, reference year 1965), whereas for herb-rich forests with deciduous (hardwood) trees the most common criterion was quantitative changes (A1, reference year 1965). The Red List category was not determined on the basis of qualitative changes as the decisive criterion for any of the herb-rich forests with deciduous (hardwood) trees, even though they were assessed also on the basis of this criterion.

Herb-rich forests with European white elm was the only habitat type of herb-rich forests with deciduous (hardwood) trees whose qualitative change resulted in classification as threatened (C/D1: VU); however, the final category of herb-rich forests with European white elm was assigned on the basis of criteria A and B. Herb-rich forests with European white elm is the most threatened habitat type among herb-rich forests with deciduous (hardwood) trees and the only one assessed as Endangered (EN). Herb-rich forests with Norway maple in turn is the only habitat type among herb-rich forests with deciduous (hardwood) trees that is not threatened but merely Near Threatened (NT). Thanks to the high protection rate of current herb-rich forests with deciduous (hardwood) trees, their future was generally assessed as positive.

All of the herb-rich forest habitat types classified by moisture and nutrient content were assessed as Data Deficient (DD) as regards quantitative changes (criteria A1–A3). Of these herb-rich forest habitat types (6 habitat types in Southern Finland and in the whole country and 5 in Northern Finland), not a single one is threatened on the basis of its geographic distribution (the B criteria). Qualitative changes (C/D criteria) resulted in 67% of them being classified as threatened in Southern Finland (and in the whole country). Of the herb-rich forest habitat types assessed in Northern Finland, 40% are threatened and the rest Near Threatened (NT) – all of them on the basis of qualitative changes.

Reasons for becoming threatened and threat factors

Clearing for agriculture (AGCL) and changes in tree species composition (FTS) are the most significant reasons for all herb-rich forest habitat types becoming threatened, and for moist herb-rich forests also drainage for forestry (DR) and for herb-rich forests with common ash also water level regulation (WBR). Likewise having a rather high significance as reasons are reductions in coarse woody debris (deadwood) (FCWD) and in individual old trees (FOG). Other reasons shared by all types but having a lower significance are mechanical soil manipulation (F, forest regeneration and silviculture measures), reduction in natural succession (FDS), and construction (CST). One of the reasons for these habitat types becoming threatened is mammal herbivory targeted at deciduous tree saplings and hindering tree recruitment (GP, grazing pressure). The threat factors in the future are very similar to the reasons of herb-rich habitat types becoming threatened, with the exception of clearing for agriculture and hydraulic construction (WHC). The factors that are more significant as threats than as reasons comprise diseases (OTF) and invasive alien species (IAS).

Trends

Among all of the 15 herb-rich forest habitat types, the trend for 5 was assessed as stable and for 10 declining in the whole country (and in Southern Finland). In Northern Finland the trend was assessed as stable for all of the assessment units.

For Southern Finland, the future of herb-rich forests with deciduous (hardwood) trees was assessed as more stable than other herb-rich forests because a higher proportion of herb-rich forests with deciduous (hardwood) trees have been protected. The trend for herb-rich forests appears to be more stable in Northern Finland than in Southern Finland because of the higher rate of protection among Northern Finland's herb-rich forests.

Comparison with previous assessment

The biggest reason for differences between the IUCN Red List categories of herb-rich forests between the current and the previous threat status assessment (Tonteri et al. 2008) is changes in assessment methodology. In the current assessment, criterion B has been introduced as a new criterion, threshold values of quantitative reductions and quality degradation used to determine Red List categories have changed, and there are no longer opportunities for uplisting or downlisting on the basis of rarity, early development or commonness of a habitat type. Because of all of the reasons mentioned above, as a general rule, herb-rich forest habitat types have been downlisted from the first assessment. There is not a single herb-rich forest habitat type whose reclassification was due to a genuine change in quantity or quality.

4.5.3 Heath forests

It was possible to assess the threat status of all of the 19 heath forest habitat types. Altogether 17 habitat types were assessed as threatened (VU–EN), with 4 of these being group-level habitat types (herb-rich, mesic, sub-xeric and xeric heath forests). Of the threatened heath forest habitat types, 9 were classified as Endangered (EN) (comprises two group-level types) and 8 as Vulnerable (VU) (comprises two group-level types) at the nationwide level (Figure 4.38). Altogether 2 habitat types were classified as Near Threatened (NT). At the nationwide level, there were 0 heath forest habitat types classified at the nationwide level as Least Concern (LC) or Critically Endangered (CR).

Southern Finland's heath forests were assessed as more threatened than those in Northern Finland. In Southern Finland, 3 heath forest types were classified as Critically Endangered (CR) and 0 habitat types were classified as Least Concern (LC), whereas in Northern Finland 1 habitat type (mature conifer-dominated herb-rich heath forests) was assessed as LC. There were 0 heath forest habitat types in Northern Finland classified as CR (Figure 4.38). This result is based on changes over the historical time frame (criteria A3 and D3, with the 1750s as the reference period). If the time frame used in the assessment was only the past 50 years (criteria A1 and D1, reference year 1965), the result would be the opposite: Northern Finland's heath forests are more threatened than those in Southern Finland. The difference between the results is highly illustrative of the differences in historical forest use between the Finnish regions. In Southern Finland, slash-and-burn agriculture and other early forms of forest use already impaired the ecological quality of forest habitat types and reduced the coverage of old-growth forests at an early stage and the pace of decline has been slowing down in the past decades, whereas in Northern Finland the corresponding changes started much later and are still ongoing.

The more nutrient-poor site types of heath forests are more threatened than the more nutrient-rich types. For example, barren heath forests are classified as Endangered (EN) in all of the examined regions, whereas herb-rich and mesic heath forests are Near Threatened (NT) in Northern Finland and Vulnerable (VU) elsewhere in the country. When examined by succession stage, forests in an old succession stage are the most threatened among heath forest habitat types. With the exception of deciduous-dominated forests, they all ended up classified as EN, and in Southern Finland old sub-xeric and xeric heath forests even as high as Critically Endangered (CR). Young succession stages were also assessed as more threatened than mature forest habitat types as, over the historical time frame (since the 1750s), the change in the quality of young forests has been greater than that of mature forests. The impact of tree species composition varies depending on the succession stage: old conifer-dominated herb-rich and mesic heath forests are more threatened than old deciduous-dominated ones, whereas mature deciduous-dominated heath forests are more threatened than mature conifer-dominated ones.

The majority of the IUCN Red List categories of heath forest habitat types were assigned on the basis of historical quality degradation (criterion D3, reference period the 1750s; Figure 4.42). For the whole country, this was the decisive criterion for 15 habitat types (including group-level habitat types), that is, for all except for the old succession stage habitat types. The category of old succession stage forests in turn was based on a historical reduction in the quantity of the habitat type (criterion A3, reference period the 1750s). At the nationwide level, there were only 3 heath forest habitat types whose Red List category was decided also by criteria other than ones based on historical change: for mature and old

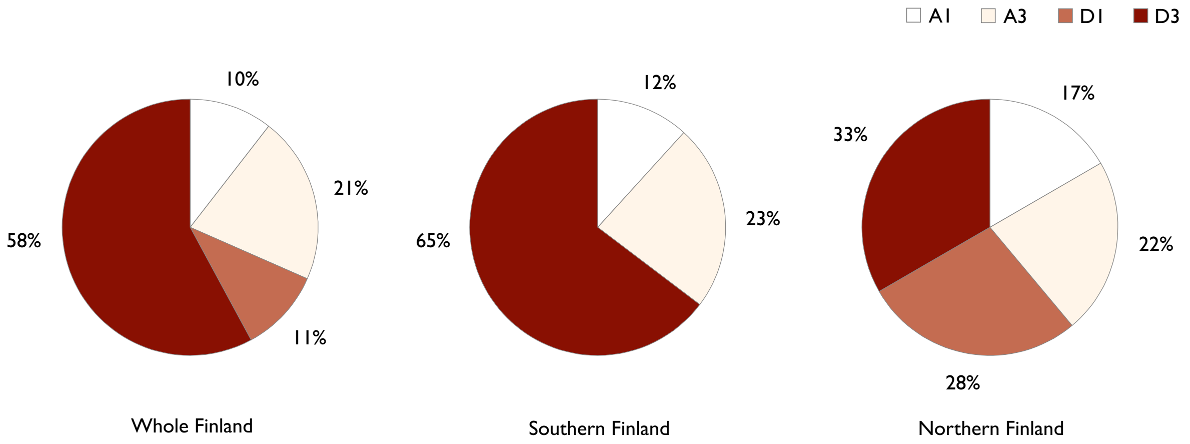

Figure 4.42. Decisive criteria determining the overall threat status for threatened and Near Threatened (NT) heath forest habitat types in the whole of Finland, in Southern Finland and in Northern Finland. For some habitat types the final IUCN Red List category was determined on the basis of more than one decisive criterion. All of these criteria are included in the figure. The figure only includes assessment units (habitat types) at the lowest hierarchical level of the classification.

deciduous-dominated heath forests a reduction in the quantity over the past 50 years (criterion A1) (for old deciduous-dominated heath forests also D1, i.e. quality deterioration over the past 50 years) and for young xeric heath forests quality deterioration over the past 50 years (criterion D1). As regards Northern Finland, on the other hand, the Red List category of 5 heath forest types was determined solely on the basis of changes over the past 50 years as the decisive criterion: herb-rich heath forests, old deciduous-dominated herb-rich and mesic heath forests as well as barren heath forests on the basis of a reduction in the quantity over the past 50 years (criterion A1), and young and mature xeric heath forests on the basis of a quality deterioration (criterion D1). In addition, for 5 other habitat types in Northern Finland, the decisive criterion was the criterion based on the past 50 years alongside the criterion based on the historical time frame (Figure 4.42).

If the threat status assessment of heath forest habitat types was conducted only on the basis of changes having taken place over the past 50 years (criteria A1 and D1) and all assessment units (including group level) were included in the examination, at the nationwide level there would be 1 habitat type (young xeric heath forests) classified as Endangered (EN), 4 (both deciduous-dominated habitat types, xeric heath forests and barren heath forests) as Vulnerable (VU), 9 as Near Threatened (NT) and 5 as Least Concern (LC). With the exception of the conifer-dominated old succession stage and deciduous-dominated heath forest types, all herb-rich heath forest habitat types and, with the exception of 2 types, all mesic heath forest habitat types would be classified as Least Concern (LC), but 0 of the more nutrient-poor habitat types would be LC. In Northern Finland, there would only be 2 LC habitat types when examined using this time frame.

Reasons for becoming threatened and threat factors

The most significant among the reasons for heath forest habitat types becoming threatened is a reduction in coarse woody debris (deadwood) (FCWD), which is one of the reasons for a total of 15 habitat types (79%) becoming threatened. A reduction in old-growth forests and individual old trees (FOG) is one of the reasons for 12 habitat types and a reduction in natural large-scale disturbances and natural succession (FDS) for 11 habitat types becoming threatened. Less significant reasons include mechanical soil manipulation (F), mammal herbivory on deciduous tree saplings (GP), atmospheric deposition of eutrophying substances (ADE) and favouring of conifers at the expense of deciduous trees (FTS). Future threats are more or less the same as the reasons but, in addition, climate change (CC) was assessed as a threat to all heath forest types, except for deciduous-dominated ones.

Trends

At the nationwide level, the trend for 6 heath forest habitat types was assessed as improving, for 4 as stable and for 9 as declining. For Southern Finland and for nutrient-rich habitat types, the trend appears more positive than for Northern Finland and for more nutrient-poor habitat types.

Comparison with previous assessment

The results of this and the previous assessment (Tonteri et al. 2008) are not directly comparable because there have been changes not only in the assessment criteria and methods but also in the classification of heath forest habitat types. All changes of category are due to either a change in method or in classification or both.

4.5.4 Special forest habitats

Of the 6 special forest habitats, 3 were assessed as Vulnerable (VU) in the whole country: sun-exposed esker forests, inland flooded forests and heath forests with deciduous (hardwood) trees. These habitat types are more threatened in Southern Finland than in Northern Finland: both sun-exposed esker forests and inland flooded forests are Endangered (EN) in Southern Finland but Near Threatened (NT) in Northern Finland. Heath forests with deciduous (hardwood) trees only occur in Southern Finland (Table 4.6, Figure 4.38).

Classified as Near Threatened (NT) at the nationwide level were 2 special forest habitats – forests on rocky terrain and forests on ultrabasic soils. They are also NT in the other examined regions, except forests on rocky terrain, which were classified as Least Concern (LC) in Northern Finland. Inland dune forests were classified as Data Deficient (DD) in all of the examined regions (Figure 4.38, Table 4.6).

The most common criteria deciding the IUCN Red List category of special forest habitats were changes in their overall quality or quantity over the historical time frame (since 1750; criterion A3, C/D3 or D3). Restricted geographic distribution coupled with the decline of the habitat type was the decisive criterion determining the Red List category of forests on ultrabasic soils. Changes in the quality and quantity of heath forests with deciduous (hardwood) trees over the past 50 years (A1 and C/D1) determined the Red List category of this habitat type. Due to lack of knowledge, many criteria were not applied at all (Not Evaluated, NE), or the habitat types were classified as Data Deficient (DD).

Reasons for becoming threatened and threat factors

Special forest habitats are a diverse and varied group of habitat types whose reasons for becoming threatened and the threats faced by them differ from each other. Significant reasons for special forest habitats becoming threatened and threats faced by them include hydraulic construction, flood protection (WHC) and water level regulation (WBR, for flooded forests) as well as gravel extraction and other mining activities (EXT) (for sun-exposed esker forests and forests on ultrabasic soils). As is the case with other forest habitat types, some special forest habitats are also threatened by a lack of forest fires (FDS), changes in tree species composition of forests (FTS), reduction in coarse woody debris (deadwood) (FCWD), reduction in old-growth forests and individual old trees (FOG), atmospheric deposition of eutrophying substances (ADE) and construction (CST).

Trends

The trend for special forest habitats was assessed as stable in all of the regions examined, with the exception of sun-exposed esker forests and flooded forests, which were assessed as the most threatened (Table 4.6). The trend for these habitat types was regarded as declining due to the continuing impact of the factors that have made them threatened. For sun-exposed esker forests these include a lack of forest fires, and eutrophication, in particular and for flooded forests water level regulation in particular. The trend for heath forests with deciduous (hardwood) trees was assessed as stable. Climate change favours deciduous (hardwood) trees, and protection of heath forests with deciduous (hardwood) trees has increased, while on the other hand these trees are threatened by diseases that are becoming more common as global warming progresses as well as by forestry on non-protected occurrence sites.

Comparison with previous assessment

The results of this and the previous threat status assessment (Tonteri et al. 2008) are not directly comparable due to changes in assessment methodology. There was not a single special forest habitat with its IUCN Red List category change based on a genuine change in its state. Instead, any uplisting or downlisting was due to a change in method and, for forests on rocky terrain, possibly also to a change in the definition of the habitat type. Also regarded as a change in method was the situation where a habitat type was now classified as Data Deficient (DD) because the IUCN criteria call for more specific data on qualitative development than the pure expert assessment used in the previous assessment. Changes of category caused by methodology were also related to aspects such as the elimination of opportunities for uplisting provided by the old assessment method and, on the other hand, the introduction of the B criterion now used as a new criterion.

At the nationwide level, the Red List category of special forest habitats remained the same for 2 habitat types, while 2 habitat types were downlisted and 1 was uplisted. There was 1 habitat type previously assessed as threatened that was now assessed as Data Deficient (DD). Corresponding changes also took place in the region-specific assessments. Consequently, any downlisting from the previous assessment should not be interpreted as an improvement in the state of the habitat type and any uplistings do not illustrate an increased risk of collapse.

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4.6

Rock outcrops and scree

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4.6.1

Threat status of rock outcrop and scree habitat types

Overall results

The overall results of the threat status assessments of rock outcrop and scree habitat types are given in Table 4.7 and Figure 4.43. For convenience, the term 'habitat type' is used below even though the figures also include three assessed habitat complexes.

Among the habitat types assessed at the nationwide level (n = 44), 25% were assessed as being threatened (VU, EN or CR), 27% as Near Threatened (NT), 43% as Least Concern (LC) and 5% as Data Deficient (DD). Altogether 2 of the threatened habitat types – calcareous rock outcrops on seashores and calcareous open flat rock outcrops – were classified as Endangered (EN). A total of 9 habitat types were assessed as being Vulnerable (VU): calcareous rock outcrops on lake shores, calcareous well-lighted and shady rock faces, flat serpentine rock outcrops, serpentine oligotrophic and serpentine calcareous rock faces, serpentine scree (block and gravel fields), calcareous taluses and calcareous erratic boulders. The habitat types classified as Near Threatened (NT) comprise habitat types from all major categories of rocky habitats. Those classified as Least Concern (LC) were mainly acidic rock outcrop and scree habitat types as well as complexes of rocky habitats. Siliceous weathered rocks and serpentine erratic boulders were regarded as Data Deficient (DD) at the nationwide level.

The surface area of the habitat types distinguished in the assessment can only be assessed at a very rough level, which is why their breakdown into the various IUCN Red List categories can also only be an indicative estimate. Because calcareous and serpentine rock outcrops only represent a combined total of less than 1% of Finland's rock outcrops, the percentage of threatened rock outcrop habitats is low on the basis of this assessment. The percentage of Near Threatened (NT) habitat types among rock outcrop and scree habitats is also low, probably below 10%. The proportion of the area covered by rock outcrop habitat types that are in reality threatened may be somewhat higher than the current estimate as it is likely that a further classification of habitat types would have found threatened habitat types also among siliceous rock outcrops. The precision of the classification is restricted by the deficiency of the data available.

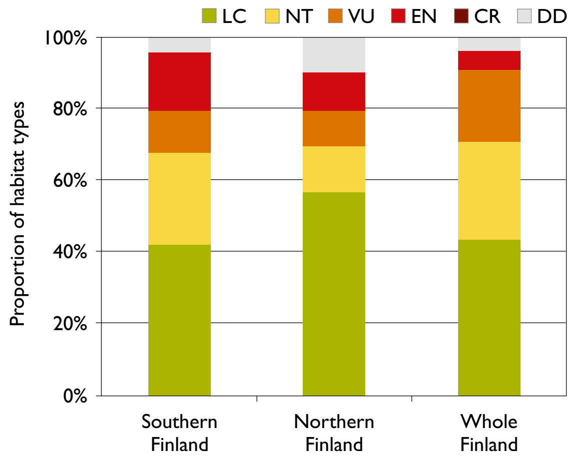


Figure 4.43. Breakdown of rock outcrop and scree habitat types into IUCN Red List categories by percentage of number of habitat types at the lowest hierarchical level in Southern Finland (43 types), Northern Finland (39 types) and the whole of Finland (44 types).

The percentage of threatened and Near Threatened (NT) habitat types is somewhat higher in Southern Finland than in Northern Finland (Table 4.7, Figure 4.43). In Southern Finland, 28% of the habitat types were assessed as threatened, 26% as Near Threatened (NT), 42% as Least Concern (LC) and 5% as Data Deficient (DD). In Northern Finland, 21% were assessed as threatened, 13% as NT, 56% as LC and 10% as DD. In addition to the habitat types classified as DD at the nationwide level and in Southern Finland, there were also 2 habitat types in Northern Finland classified as DD: calcareous open and calcareous wooded flat rock outcrops. The difference in the percentages of threatened and Near Threatened habitat types between the subregions is explained by differences in land use intensity. The most important individual factors behind the dissimilarity are differences relating to the quantitative reduction in calcareous rock outcrops and to the qualitative decline of all of the shady rock face types. These changes were assessed as being stronger in Southern Finland than in Northern Finland.

Group-specific results

The proportions of threatened and Near Threatened (NT) habitat types are highest in the groups of calcareous and serpentine rock outcrops (Figure 4.44). All calcareous rock outcrops in Southern Finland were assessed as being threatened. In contrast, in Northern Finland calcareous rock outcrops on lakeshores were classified as Vulnerable (VU) and the other calcareous rock outcrop types as Near Threatened (NT) or Data Deficient (DD). The threat status of calcareous rock outcrops was determined variably on the basis of a quantitative reduction over the past 50 years or over the historical time frame (criteria A1 and A3), on the basis of decline combined with the habitat type's rarity (criterion B) and, especially in Southern Finland, also on the basis of strong biotic decline (criteria D1 and D3) being decisive criteria. The generally lower threat status of Northern Finland's calcareous rock outcrops is explained by the focus of their occurrence being on the Oulanka National Park.

Among serpentine rock outcrop habitat types, the majority were classified as threatened in Southern as well as in Northern Finland, with their threat status determined on the basis of deterioration coupled with rarity (criterion B) being the decisive criterion.

Siliceous rock outcrop habitat types were assessed as Near Threatened (NT), Least Concern (LC) or Data Deficient (DD). In most cases, the reason for classification as NT was the biotic decline of occurrences over the historical time frame (criterion D3) or both abiotic and biotic decline over the past 50 years (criterion CD1). The NT group contains more intermediate-basic than acidic rock outcrop habitat types (Table 4.7). The causes underlying the difference are described in the following section.

All siliceous rock outcrop types were assessed as Least Concern (LC). Calcareous taluses and calcareous erratic boulders were, however, regarded as Vulnerable (VU). All complexes of rocky habitats were classified as LC.

Criterion-specific results and criteria decisive for the final IUCN Red List categories

In the assessment of the threat status of rock outcrop and scree habitat types, the usage rate of criteria A and B was to some extent higher than that of the other criteria (Figure 4.45). This means that data on quantitative changes in habitat types (criterion A) or on their geographic distribution (criterion B) was available and therefore utilised more often than that on their qualitative changes (criteria C and D).

In around 40% of the assessment cases, all of the criteria used yielded the same result – Least Concern (LC). This result is explained by the fact that a large proportion of acidic and intermediate-basic rock outcrop and scree types are quite common (criterion B) and have undergone only small quantitative (criterion A) and qualitative (criteria D and CD) changes.

As regards those rock outcrop and scree habitat types that were classified as Near Threatened or threatened (NT–CR) in the nationwide assessment, the decisive criterion determining the final result was most commonly B2 (restricted area of occupancy), usually combined with the habitat type's continuing decline (Figure 4.46). This applied particularly to serpentine rock outcrops and part of calcareous rock outcrops. In 6 assessments, the IUCN Red List category was based entirely or in part on a quality decline over the past 50 years (C/D1) and

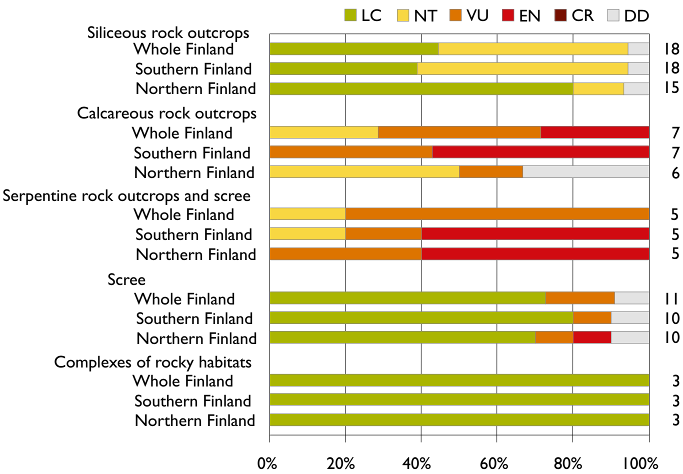


Figure 4.44. Breakdown of rock outcrop and scree habitat types into IUCN Red List categories in the whole of Finland, Southern Finland and Northern Finland by main group of habitats (percentages of numbers of habitat types at the lowest level of hierarchy). Figures on the right show the numbers of assessed habitat types for each of the main groups in the given region. In this graph, Fe and Cu sulphide-rich rock outcrops are included siliceous rock outcrops.

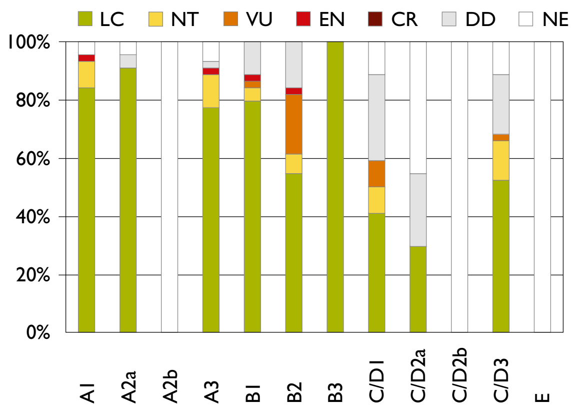


Figure 4.45. Rock outcrop and scree habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria for the whole of Finland. The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. The figure only includes assessment units at the lowest hierarchical level of the classification (44 types).

in 4 on a quality decline over the historical time frame (C/D3). It was specifically on the basis of qualitative changes that some common or fairly common habitat types such as acidic and intermediate-basic shady rock faces were classified as Near Threatened (NT).

In the assessments covering the whole country, quantitative changes over the past 50 years or over the historical time frame (A1 or A3) resulted in intermediate-basic open flat rock outcrops and 3 calcareous rock outcrop habitat types being classified as Near Threatened (NT) or threatened (see Table 4.7).

Trends

At the nationwide level, the near-term trend for 48% of rock outcrop and scree habitat types was regarded as stable and for 43% declining, while the trend for 9% could not be assessed. When examined specifically for each region, the corresponding figures for Southern Finland were 47% being stable, 49% declining and 5% unknown and for Northern Finland 62% stable, 13% declining and 26% unknown.

Habitat types regarded as undergoing continuing decline included calcareous rock outcrops, whose overgrowth is likely to progress further in the near future, too, because management measures on occurrences are insufficient. Further decline or deterioration of non-protected sites is also caused by construction and intensive forestry. The trend for serpentine rock outcrops was also regarded as declining even though the observed deterioration is, on average, less severe and probably slower than in calcareous rock outcrops.

The trend could not be assessed for Data Deficient (DD) types, which is why the trend was regarded as unknown for habitat types including certain calcareous rock outcrop types in Northern Finland as there is no knowledge of their overgrowth development.

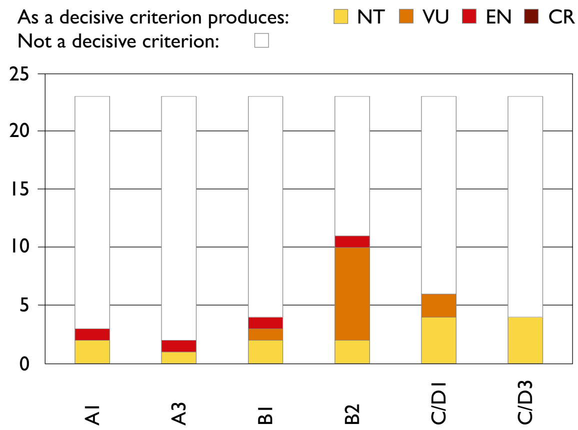
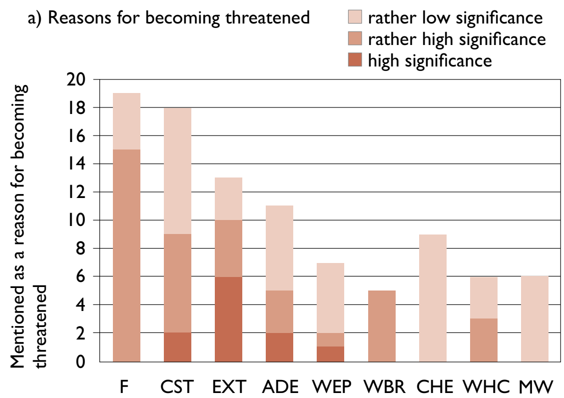


Figure 4.46. Decisive criteria determining the overall threat status for threatened and Near Threatened (NT) rock outcrop and scree habitat types in the assessments concerning the whole country. The y-axis shows the total number of threatened and NT habitat types (23 types) and the coloured sections of the bars indicate the number of habitat types for which the criterion in question alone or together with another criterion was the decisive criterion determining the overall threat status. The colours also represent the IUCN Red List categories assigned on the basis of the assessment.

4.6.2
Reasons for becoming threatened and threat factors

Reasons regarded as the most important ones for rock outcrop and scree habitat types becoming threatened were forestry, construction and extractive activities (Figure 4.47a). Forest regeneration and management measures concerning rock outcrops specifically cause qualitative decline. They cause both microclimate changes due to tree felling and, for example, overgrowth of open surfaces in the vicinity of dense-planted sapling stands. The second-most important reason for these habitat types becoming threatened is construction, which is a significant one especially for rock outcrops on shores and for calcareous rock outcrop habitat types. Extractive activities include all types of rock excavation, measures related to establishing and operating mines, and also extraction of stone material. Among the reasons for habitat types becoming threatened, examples of extractive activities include excavation of calcareous rock outcrops and soapstone, which already began centuries ago, but also the extraction of rock aggregate



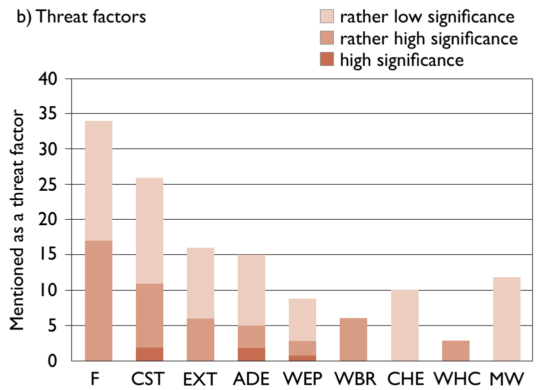


Figure 4.47. Reasons for becoming threatened (a) and threat factors (b) of rock outcrop and scree habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

Table 4.7. Results of the threat status assessment of rock outcrop and scree habitat types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
K	**Rock outcrops and scree**									
K1	**Siliceous rock outcrops**									
K1.01	Acidic rock outcrops on seashores	F	LC			=	LC			CST 2, WEP 2, MW 1, ADE 1
		SF	LC			=	LC			
		NF								
K1.02	Acidic rock outcrops on lakeshores	F	LC			=	LC			CST 2, WBR 2, WEP 1, MW 1, ADE 1
		SF	LC	LC–NT		=	LC			
		NF	LC			=	LC			
K1.03	Acidic rock outcrops on riverbanks	F	NT	LC–NT	CD1	=	NT		WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1	WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1
		SF	NT	LC–NT	CD1	=	NT			
		NF	NT	LC–NT	CD1	=	NT			
K1.04	Acidic rock outcrops with *Racomitrium lanuginosum*	F	LC	LC–NT		=	NT	3		EXT 1, CST 1, MW 1, ADE 1, F 1
		SF	LC	LC–NT		=	NT	3		
		NF								
K1.05	Acidic rock outcrops with reindeer lichen and mosses	F	LC	LC–NT		=	LC		F 2, ADE 1, EXT 1, CST 1	F 2, ADE 1, EXT 1, CST 1
		SF	NT	LC–VU	D3	–	LC	2		
		NF	LC	LC–NT		=	LC			
K1.06	Acidic well-lighted rock faces	F	LC			=	LC			F 1, CST 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K1.07	Acidic shady rock faces	F	NT	LC–NT	D3	–	NT		F 2, CST 1	F 2, CST 1
		SF	NT	LC–NT	D3	–	NT			
		NF	LC			=	LC			
K1.08	Acidic overhanging rock faces	F	NT	LC–NT	D3	–	NT		F 2, MW 1, CST 1	F 2, MW 1, CST 1
		SF	NT	LC–NT	D3	–	NT			
		NF	LC			=	LC			
K1.09	Siliceous rock faces with seepage water	F	LC			=	LC			F 1, CST 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K1.10	Siliceous weathered rocks	F	DD		B2, D1–D3	?	NT	3		EXT 2, F 2
		SF	DD		B1, B2, D1–D3	?	NT	3		
		NF	DD		B1, B2, D1–D3	?	LC	3		
K1.11	Intermediate-basic rock outcrops on seashores	F	NT	LC–NT	CD1	–	NT		CST 2, WEP 2, CHE 1, MW 1, ADE 1	CST 2, WEP 2, MW 1, CHE 1, ADE 1
		SF	NT	LC–NT	CD1	–	NT			
		NF								
K1.12	Intermediate-basic rock outcrops on lakeshores	F	NT	LC–NT	CD1	–	NT		CST 2, WBR 2, WEP 1, CHE 1, MW 1, ADE 1	CST 2, WBR 2, CHE 1, WEP 1, MW 1, ADE 1
		SF	NT	LC–NT	CD1	–	NT			
		NF	LC			=	LC			
K1.13	Intermediate-basic rock outcrops on riverbanks	F	NT	LC–NT	CD1	=	NT		WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1	WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1
		SF	NT	LC–NT	CD1	=	NT			
		NF	NT	LC–NT	CD1	=	NT			
K1.14	Intermediate-basic open flat rocks	F	NT		A1	–	NT		ADE 2, F 2, CHE 1, CST 1, EXT 1	ADE 2, F 2, CHE 1, CST 1, EXT 1
		SF	NT		A1	–	NT			
		NF	LC			=	LC			
K1.15	Intermediate-basic well-lighted rock faces	F	LC			=	LC			F 1, CST 1, CHE 1, ADE 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K1.16	Intermediate-basic shady rock faces	F	NT	LC–VU	D3	–	NT		F 2, CST 1, CHE 1, ADE 1	F 2, CST 1, CHE 1, ADE 1
		SF	NT	LC–VU	D3	–	NT			
		NF	LC			=	LC			
K1.17	Intermediate-basic overhanging rock faces	F	NT	LC–VU	D3	–	NT		F 2, MW 1, CST 1	F 2, MW 1, CST 1
		SF	NT	LC–VU	D3	–	NT			
		NF	LC			=	LC			

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
K2	**Calcareous rock outcrops**	F	NT		A3, D1, D3	–	VU	3	EXT 3, F 2, ADE 2, CST 2, WEP 1, WHC 1, CHE 1	F 2, ADE 2, CST 2, EXT 2, WEP 1, CHE 1
		SF	VU		A3, D1, D3	–	VU			
		NF	NT		B1,2a(iii)b	?	NT			
K2.01	Calcareous rock outcrops on seashores	F	EN		B1a(ii,iii)b	–	VU	3	EXT 3, CST 3, WEP 3, ADE 2, CHE 1	CST 3, WEP 3, ADE 2, CHE 1
		SF	EN		B1a(ii,iii)b	–	VU	3		
		NF								
K2.02	Calcareous rock outcrops on lakeshores	F	VU		B2a(ii,iii)b	–	VU		CST 3, EXT 2, ADE 2, WEP 1, F 1, CHE 1	CST 3, ADE 2, WEP 1, F 1, CHE 1
		SF	EN		B2a(ii,iii)b	–	VU	3		
		NF	VU		B1,2c	?	NT	3		
K2.03	Calcareous rock outcrops on riverbanks	F	NT	LC–EN	A1, B1,2a(ii)b	?	NT		WHC 2, WBR 2, CST 1, F 1, WEP 1	WHC 2, WBR 2, CST 1, F 1, WEP 1
		SF	EN		B1,2a(ii)bc	–	EN			
		NF	NT	LC–EN	A1, B1,2a(ii)b	?	NT			
K2.04	Calcareous open flat rock outcrops	F	EN		A1, A3, B2a(iii)b	–	CR	3	EXT 3, ADE 3, F 2, CST 2, CHE 1	ADE 3, F 2, CST 2, EXT 2, CHE 1
		SF	EN		A1, A3, B2a(iii)b	–	CR	3		
		NF	DD		A1–A3, B1–B3, D1, D3	?	DD			
K2.05	Calcareous wooded flat rock outcrops	F	NT	LC–VU	A3	–	VU	3	EXT 3, ADE 3, F 2, CST 2	ADE 3, F 2, CST 2, EXT 2
		SF	VU	NT–VU	A3	–	VU			
		NF	DD		B1, B2, D1, D3	?	VU	3		
K2.06	Calcareous well-lighted rock faces	F	VU		B2a(iii)b, D1	–	NT	3	EXT 3, F 2, CST 2, ADE 1	F 2, CST 2, ADE 1, EXT 1
		SF	VU		A3, B2a(iii)b, D1, D3	–	EN	3		
		NF	NT	LC–EN	B1,2a(iii)b	?	NT			
K2.07	Calcareous shady rock faces	F	VU	NT–VU	D1	–	VU		EXT 3, F 2, CST 2, ADE 1	F 2, CST 2, ADE 1, EXT 1
		SF	VU		A3, B2a(iii)b, D1, D3	–	VU			
		NF	NT	LC–EN	B1,2a(iii)b	?	NT			
K3	**Serpentine rock outcrops and scree**									
K3.01	Serpentine rock outcrops on shores	F	NT	LC–EN	B1,2a(iii)b	–	VU	3	CST 1-2, WBR 1-2, F 1	CST 1-2, WBR 1-2, F 1, EXT 1
		SF	NT	LC–EN	B1,2a(iii)b	–	VU	3		
		NF	EN		B1,2c	?	EN			
K3.02	Flat serpentine rock outcrops	F	VU	NT–VU	B2a(iii)b	–	VU		F 2, EXT 2, WHC 1	F 2, EXT 2
		SF	VU	VU–EN	B2a(iii)b	–	VU			
		NF	VU		B2a(iii)b	–	VU			
K3.03	Serpentine oligotrophic rock faces	F	VU		B2a(iii)b	–	VU		F 2, EXT 2, WHC 1	F 2, EXT 2
		SF	EN	VU–EN	B2a(iii)b	–	VU	3		
		NF	EN		B2a(iii)b	–	VU	3		
K3.04	Serpentine calcareous rock faces	F	VU		B2a(iii)b	–	VU		F 2, EXT 2, WHC 1	F 2, EXT 2
		SF	EN		B2a(iii)b	–	VU	3		
		NF	EN		B2a(iii)b	–	VU	3		
K3.05	Serpentine scree (block and gravel fields)	F	VU		B2a(iii)b	–	NT	3	F 2, EXT 1	F 2, EXT 1
		SF	EN		B2a(iii)b	–	–	2		
		NF	VU		B2a(iii)b	–	NT	3		
K4	**Fe and Cu sulphide-rich rock outcrops**	F	LC			=	NT	3		F 2, EXT 1, CST 1
		SF	LC			=	NT	3		
		NF	LC			=	LC			

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
K5	**Scree**									
K5.01	Boulder fields of raised beaches near the Baltic coast (rather young)	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF								
K5.02	Boulder fields of raised beaches inland (ancient)	F	LC			=	NT	3		EXT 1, F 1
		SF	LC			=	NT	3		
		NF	LC			=	LC			
K5.03	Fluvial boulder fields	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.04	Frost-weathered boulder fields	F	LC			=	LC			
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.05	Frost-heaved boulder fields	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.06	Moraine boulder fields	F	LC			=	LC			F 1, EXT 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.07	Taluses									
K5.07.01	Siliceous taluses	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.07.02	Calcareous taluses	F	VU		B1,2c	?		4	F 1	F 1
		SF								
		NF	VU		B1,2c	?		4		
K5.08	Erratic boulders, tors and stacks									
K5.08.01	Siliceous erratic boulders, tors and stacks	F	LC			=	LC			
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.08.02	Calcareous erratic boulders	F	VU		B2a(iii)b	–	NT	3	EXT 3, F 2	F 2
		SF	VU		B2a(iii)b	–	NT	3		
		NF	EN		B2a(iii)b	–	NT	3		
K5.08.03	Serpentine erratic boulders	F	DD		B1, B2, D1–D3	?	NT	3		F 1
		SF	DD		B1, B2, D1–D3	?	NT	3		
		NF	DD		B1, B2, D1–D3	?	NT	3		
K6	**Complexes of rocky habitats**									
K6.01	Canyons	F	LC			=	LC			F 1, CST 1, MW 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K6.02	Gorges	F	LC			=	LC			MW 1, F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K6.03	Caves	F	LC			=	LC			MW 1
		SF	LC			=	LC			
		NF	LC			=	LC			

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Figure 4.48. Limestone quarry in Pargas. Photo: Terhi Korvenpää

as material replacing gravel and sand, and bedrock excavation in conjunction with, for example, large-scale construction projects.

Regarded as the most significant future threats for rock outcrop and scree habitat types, too, were forestry, construction and extractive activities (Figure 4.47b). The result with regard to forestry and construction is explained by the large extent of these threats as, in their various forms, they affect almost all rock outcrop and scree habitat types. The relative significance of extractive activities as a threat has become somewhat lower (cf. Figure 4.47a). This is likely to be related to the fact that the economically significant deposits in, for example, calcareous rock outcrops have already been exploited.

There are several reasons mentioned for why calcareous rock outcrops are threatened or Near Threatened (NT), with the most important ones being excavation that already started a long time ago and factors affecting them closer to the present day, namely construction, overgrowth relating to causes including atmospheric deposition of eutrophying substances, as well as forest regeneration and management measures. Calcareous rock outcrops have been excavated in Finland for at least since the 1500s, and Southern Finland's largest calcareous rock outcrop areas have for the most part been reserved for lime production (Figure 4.48). In Southern Finland, excavation had taken place on a considerable proportion – even up to half – of limestone deposits on the surface as early as at the beginning of the 1900s (Eskola et al. 1919). In Northern Finland, the percentage of excavated sites was below 10% at that point. Because excavation has focused specifically on the more extensive calcareous rock outcrops, the percentage of calcareous rock outcrop area that has been excavated is even higher than the proportion of excavated rock outcrops of the total number of rock outcrops. It should be noted regarding calcareous rock outcrops that the impact of excavation has not been solely destructive or always resulted in biodiversity depletion. Instead, excavation has also created geomorphological variation, that is, rock faces, piles of stones and open rock surfaces in previously low-relief or covered rock ridges. Nowadays lime excavation is fairly concentrated geographically and mostly takes place underground, so it is regarded as a less important threat among future threat factors. With economic trends changing, extractive activities can still, however, be regarded as a threat to calcareous rock outcrops at least with regard to the economically most significant deposits.

Especially in Southern Finland, calcareous rock outcrops, which are often very small in area, have been destroyed or altered by construction. In this context, construction comprises major construction projects such as road or suburban construction but also smaller-scale construction on sites such as shores. Around 30% of Southern Finland's calcareous rock outcrops are protected or are going to be protected. In Northern Finland the percentage of protected ones is higher – around or over 70%. Another significant reason for rock habitat types becoming threatened and constituting a threat to them is overgrowth, with atmospheric deposition of eutrophying substances and a lack of forest fires being regarded as the most significant background factors to this. Overgrowth is also accelerated by increases in carbon dioxide levels and temperatures. The discontinuation of grazing on woodland pastures has likewise increased the vegetation cover of calcareous rock outcrops. Overgrowth is boosted by dense-planted sapling stands, which produce needle

litter at a rapid rate, so this threat is clearly connected to forest regeneration measures. Needle litter not only covers rock outcrops but is also acidic and therefore impoverishes the biotic communities of calcareous rock outcrops. On the other hand, felling has impaired the living conditions of communities adapted to the humid and uniform microclimate of shady calcareous rock outcrops in particular. The quality, and in part also the quantity, of calcareous rock outcrops on shores has been affected, especially in northern water bodies, by water level regulation and hydraulic construction and, in Southern Finland, by eutrophication of water bodies. Biotic communities of calcareous rock outcrops are assessed as having been impoverished to some extent due to acid deposition as well.

Forestry and extractive activities were regarded as the most significant among the reasons for serpentine rock outcrops becoming threatened and among the threat factors faced by these habitat types. Excavation of soapstone, which is used mainly in wood-burning stoves and fireplaces, and serpentinite, which is used to make wall tiles, has so far destroyed a relatively small proportion of serpentine rock outcrops, but the threat exists due to the potential growth of soapstone industry. In addition, serpentine rock outcrops are often located in ore-critical areas where a rather high number of claims have been made because of deposits such as nickel, copper and zinc. Although ore excavation mostly takes place underground, above-ground structures related to any mines (such as roads and rock waste dumps) pose a serious threat to above-surface rock formations, too. In Lapland, ultrabasic rock outcrops have been submerged at least by the Lokka Reservoir. Serpentine rock outcrops often occur in forest environments in the form of small open or sparsely wooded patches, and active afforestation within or in the perimeter of the area may, through accelerating overgrowth, pose a threat to serpentine rock outcrops, too. This is regardless of the fact that forest growth is often weak on serpentine substrates. Around 30% of serpentine rock outcrops and scree are protected or are going to be protected in Southern Finland, and the corresponding figure for Northern Finland is around 40%.

As regards siliceous rock outcrops, it is not easy to name significant reasons for the entire group becoming threatened or significant threats faced by the entire group. The most significant reason for shady rock faces becoming threatened is, however, tree felling in front of them (Figure 4.49). Examination of aerial photographs carried out in conjunction with the previous assessment found that, in Southern Finland, around 10% of north-, northeast- and east-facing rock faces are located without a buffer zone in freshly felled areas, whereas in Northern Finland felling of the forests lying directly underneath shady rock faces did not appear as intensive at that point. Felling extending close to a rock face makes the microclimate drier and more extreme, which results in the loss of species that require a humid and shady site or in such species only being preserved in the most sheltered cavities. The species composition of the rock face becomes temporarily or permanently poorer and the recovery of the physiognomy of rock face vegetation takes decades at the very least.

Since 1997, some rock faces have been included in the Forest Act's (1093/1996) habitat of special importance of "steep bluffs and the forest lying directly underneath". The Forest Decree (1200/1996) and the decision of the Ministry of Agriculture and Forestry on the application of the Forest Act (224/1997) narrowed down the scope of application of the Act's habitats of special importance in many ways: habitats such as rock faces were required in general to be at least 10 metres high and to overshadow the forest lying directly underneath them and, in addition, "cautious" fellings were permitted.

The new Forest Act (since 2014) has generally narrowed down the scope of application of habitats of special importance, with the justification for this being the Forestry Centres' practices regarding the interpretation of the 1996 Act. With regard to rock faces, however, the new Act also contains two improvements compared with the application of the old Act. Steep rock faces (bluffs) is the only habitat type in the Forest Act where wood harvesting is not permitted and, according to the Forestry Centre guidelines on the application of the Act, light-exposed rock faces can also be habitats of special importance specified by the Act.

It appears on the basis of field observations and studies (e.g. Pykälä 2007) that the 1996 Forest Act curbed felling on shady rock faces only in a small proportion of their occurrences.

Regardless of the above-mentioned improvements, the new Forest Act does not improve the protection situation of rock faces as a whole as the forest owner's own contribution has been cut, environmental aid for forestry has been reduced, sites pursuant to the Forest Act must always be small in area or have little significance for forestry purposes, and the problematic issues observed by studies in the old Act's application have not been rectified. Consequently, the area covered by rock faces safeguarded by the current Forest Act is likely to be smaller compared with the old Act.

Acidic and intermediate-basic rock outcrops on riverbanks were assessed as Near Threatened (NT), mainly due to hydraulic construction and water level regulation. A large proportion of Finland's rivers and streams are regulated these days, but the impacts of regulation on biotic communities of rock outcrops on shores are poorly known. The absence of high flood peaks in regulated water bodies probably increases the overgrowth of shore rock outcrops, and the non-

◄ Figure 4.49. Felling in front of a rock face changes its microclimate, resulting in the loss of or reduction in species that require a humid and shady site. Photo: Jari Teeriaho natural regime and intensity of water level fluctuation is likely to have adverse effects on species in the riparian or littoral zone of rock outcrops. The classification of many intermediate-basic rock outcrop habitat types as Near Threatened (NT) was co-affected by multiple threat factors. Intermediate-basic rock outcrops are more vulnerable to overgrowth, the underlying causes of which are nitrogen deposition and reductions in forest fires and in grazing on woodland pastures. Biotic communities of intermediate-basic rock outcrops have also been adversely affected by acid deposition. Even though the volumes of acid deposition have taken a downturn, any recovery in rock outcrop species is yet to be observed.

In principle, rock outcrop excavation poses a threat to siliceous rock outcrop habitat types but, relative to the abundance of these habitat types' occurrence, the threat is low when examined at the nationwide level or by subregion. Locally, however, rock excavation may pose a significant threat, especially to rarer intermediate-basic rock outcrop habitat types.

As regards scree types, most were assessed as Least Concern (LC) and not facing any particularly significant future threats. On the other hand, in previous centuries calcareous erratic boulders used to be crushed for use as a soil conditioner and in the future they will continue to be adversely affected by forestry measures, too.

All of the complex types of rocky habitats mentioned in the threat status assessment were classified as Least Concern (LC). Being extensive entities or special natural attractions, they face only minor quantitative threats. In contrast, their identified qualitative threats comprise mechanical wear and forest management impacts which, however, were not assessed as significant in relation to the overall quality of the occurrences.

IUCN method 2018 \ National method 2008	LC	NT	VU	EN	CR	DD	NE
LC	16	3					
NT		10	2				
VU		3	5				1
EN			1		1		
CR							
DD		2					

Figure 4.50. Red List categories of rock outcrop and scree habitat types for the whole of Finland using IUCN methodology in 2018 and their classification based on the national method in 2008. The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassifications. Figures in the NE column refer to new habitat types that were separated only in the second assessment in 2018.

4.6.3
Comparison with previous assessment

As the method employed to assess threat status changed from the national method to IUCN methodology, the results of the first and second assessment are not directly comparable (cf. Kontula et al. 2008). However, efforts have been made to examine the IUCN Red List category changes of habitat types (Figure 4.50) and to analyse the reasons behind them.

Among rock outcrop and scree habitat types, there was not a single case of a category change regarded as being due to a genuine change. Instead, the reclassifications were mainly due to a change in method. There were 6 cases of downlisting and 4 cases of uplisting, in addition to which 2 habitat types were reclassified from Near Threatened (NT) to Data Deficient (DD) and 1 new habitat type – calcareous taluses – was included in the assessment. The reasons for changes of category due to methodology were related, for example, to the elimination of opportunities for uplisting that had been provided by the old assessment method and, on the other hand, to the new methodology allowing habitat types to be placed in higher categories on the basis of criterion B than on the basis of the rarity-based uplisting employed in the old method. Any downlisting of habitat types from the previous assessment should not be interpreted as any improvement in their state and any uplistings do not in these cases indicate an increased risk of collapse.

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Rock outcrops and scree

4.7

Seminatural grasslands and wooded pastures

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4.7.1
Threat status of seminatural grasslands and wooded pastures

The rate of loss of meadows, wooded pastures and grazed woodlands has been very high and the quality of these habitats has also declined. Traditional livestock farming practices have been discontinued or been altered so that they are less sustaining of the characteristic features of seminatural grasslands and wooded pastures. Managed habitat types that require other measures besides grazing in order to be preserved, such as traditional mowed meadows or pollard meadows, have changed in character and turned into other types of seminatural grassland. Seminatural grasslands and wooded pastures have also been destroyed by land use changes. Changes detrimental to biodiversity that have taken place in seminatural grasslands and wooded pastures have progressed very far, and the management objectives set have not been reached, which can also be seen clearly in the results of the threat status assessment of these habitat types (Table 4.8) and in their species that continue to decline.

All of the seminatural grassland and wooded pasture habitat type groups (12) and habitat types (40) examined in the assessment occur or have occurred in Southern Finland. In contrast, in Northern Finland there are only 8 seminatural grassland and wooded pasture habitat type groups and, within these, 25 habitat types, of which 5 are Data Deficient (DD).

According to the assessment, all of the meadows, wooded pastures and grazed woodlands are threatened when examined at the level of habitat type groups. Of the 12 habitat type groups examined, 11 were assessed as Critically Endangered (CR) and 1 as Endangered (EN) in the whole country. The categories assigned concerning Southern Finland are the same as those for the whole country. The categories for Northern Finland are also mainly in line with the nationwide assessment.

The strong increase in the threat status of seminatural grasslands and wooded pastures can also be seen in the habitat type level examination. Among the 40 meadow,

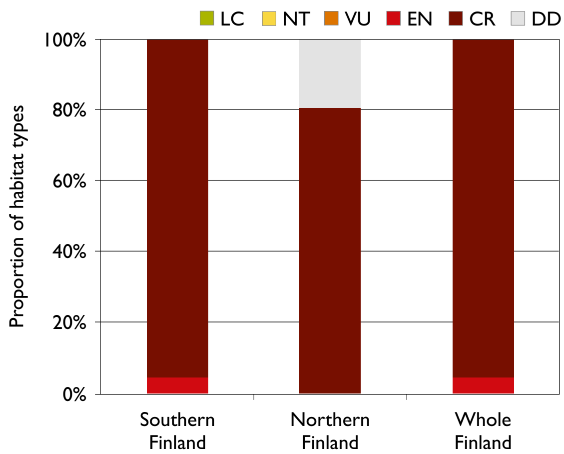


Figure 4.51. Breakdown of seminatural grassland and wooded pasture habitat types into IUCN Red List categories by percentage of number of habitat types at the lowest hierarchical level in Southern Finland (42 types), Northern Finland (26 types) and the whole of Finland (42 types).

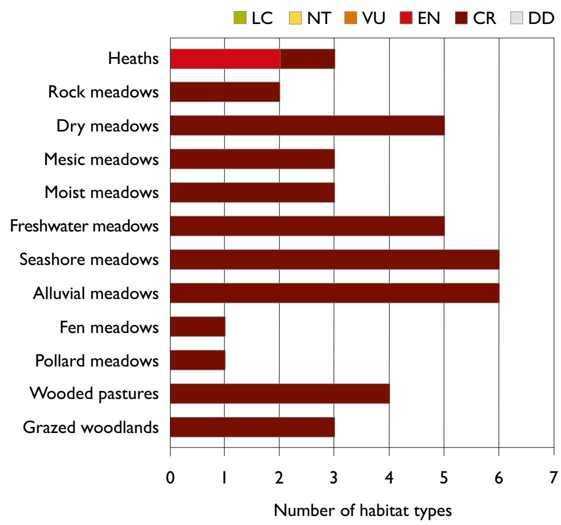


Figure 4.52. Breakdown of seminatural grassland and wooded pasture habitat types into IUCN Red List Categories in the whole of Finland by main group of habitats (percentages of numbers of habitat types at the lowest level of hierarchy).

wooded pasture and grazed woodland habitat types assessed, 38 were classified as Critically Endangered (CR) and 2 as Endangered (EN) in the whole country. There are 5 habitat types that are Data Deficient (DD). Alder meadows were found in the previous assessment to be Regionally Extinct (RE) in Finland but were not regarded as an assessment unit in this assessment due to a change in classification. Other seminatural grassland or grazed woodland habitat types have presumably also disappeared from Finland but, due to the scant previous descriptions of their vegetation, their previous existence cannot be verified. There are 0 seminatural grassland or grazed woodland habitat types classified as Least Concern (LC), Near Threatened (NT) or Vulnerable (VU). Fen meadows and pollard meadows were only assessed as habitat type groups without distinguishing any more specific habitat types within them. Figures 4.51 and 4.52 show the results in accordance with the lowest hierarchical level of the classification, with the examination taking into account the habitat type level, and fen meadows and pollard meadows, which were only assessed at the group level.

In the examination of the threat status of habitat types by region, the assessments concerning Southern Finland yielded the same IUCN Red List categories as the nationwide assessments. Of Northern Finland's habitat types, 21 are Critically Endangered (CR) and 5 are Data Deficient (DD).

4.7.2 Most threatened habitat type groups and habitat types

Meadows, wooded pastures and grazed woodlands are as a whole highly threatened as the majority of their habitat type groups and habitat types were classified as Critically Endangered (CR). There are 0 seminatural grassland and wooded pasture habitat types classified as Least Concern (LC) in Finland. In Northern Finland, too, the occurrences of meadow and wooded pasture types classified as Data Deficient (DD) are known to have declined, but the degree of this reduction is unknown.

Rock meadows, dry meadows, mesic meadows, moist meadows, freshwater meadows, seashore meadows, alluvial meadows, fen meadows, pollard meadows, wooded pastures and grazed woodlands proved to be the most threatened seminatural habitat type groups as all of the habitat types included in these groups were classified as Critically Endangered (CR) (Figure 4.52). Heaths are assessed as a habitat type group that is Endangered (EN). In the nationwide assessment, herb-rich heaths is a habitat type that is more threatened than its group as a whole.

In addition to the strong quantitative reduction and the significant decline in quality, some of the Critically Endangered (CR) habitat types are extremely rare and very small in terms of their total surface area. These include herb-rich heaths (10–50 ha), calcareous rock meadows (30–40 ha), calcareous dry meadows (approx. 70 ha), acidic low-herb-rich dry meadows (approx. 70 ha), dwarf-shrub-rich dry meadows (approx. 35 ha), tall-herb mesic meadows (150 ha), calcareous moist meadows (20–40 ha), salt patches (60–100 ha), *Eleocharis acicularis* freshwater meadows (5–10 ha), *Equisetum fluviatile* alluvial meadows (approx. 95 ha) and pollard meadows (approx. 100 ha). Additionally, the remaining *Avenula pubescens* dry meadows, grass-rich moist meadows and possibly also tall freshwater meadows (110–230 ha) each cover an area less than 150 ha in size. Generally speaking, there are only very few representative and high-quality sites remaining among seminatural grasslands and wooded pastures. The qualitative assessment of these occurrences was made more difficult by the habitat types being difficult to identify and often located in patches inside another habitat type.

4.7.3 Quantitative and qualitative changes in and criterion-specific results of seminatural grasslands and wooded pastures

Quantitative changes from the 1960s to the present day alone (A1) put most meadow, wooded pasture and grazed woodland habitat types in the highest IUCN Red List categories (Figure 4.53). Quantitative assessment over the historical time frame (A3) also produced the Critically Endangered (CR) category in all cases where the degree of reduction could be determined. In contrast, qualitative examinations (CD1–CD3) in most cases resulted in the category being Data Deficient (DD) or indicated somewhat lower threat categories than quantitative changes. This is explained by the fact that qualitative changes could only be assessed through comparisons with occurrences that have been preserved until the present day.

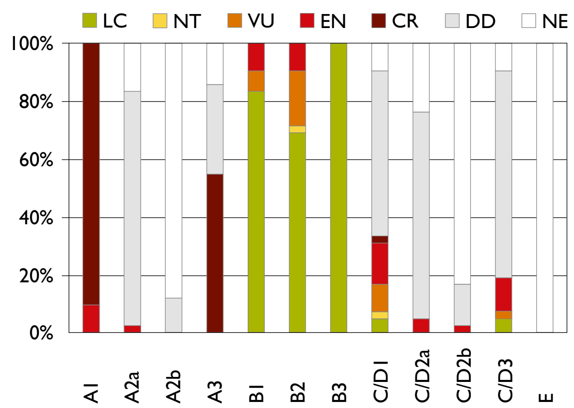


Figure 4.53. Seminatural grassland and wooded pasture habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria for the whole of Finland. The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. The figure only includes assessment units at the lowest hierarchical level of the classification (42 types).

Table 4.8. Results of the threat status assessment of seminatural grassland and wooded pasture habitat types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
P	**Seminatural grasslands and grazed woodlands**									
P01	**Heaths**	F	EN	EN–CR	A1, A3, CD1	–	CR	3	OGR 3, FDS 2, ADE 2, F 1, CST 1	OGR 3, FDS 2, ADE 2, CST 1, CC 1, CHE 1
		SF	EN	EN–CR	A1, A3, CD1	–	CR	3		
		NF								
P01.01	Herb-rich heaths	F	CR		A1, CD1	–	CR		OGR 3, FDS 2, ADE 2, F 1, CST 1	OGR 3, FDS 2, ADE 2, CST 1, MW 1, F 1, CC 1, CHE 1, IAS 1
		SF	CR		A1, CD1	–	CR			
		NF								
P01.02	Graminoid heaths	F	EN		A1, CD1	–	CR	2, 3	OGR 3, ADE 2, FDS 2	OGR 3, ADE 2, CC 1, CST 1, IAS 1
		SF	EN		A1, CD1	–	CR	2, 3		
		NF								
P01.03	Dwarf-shrub heaths	F	EN	EN–CR	A1, CD1	–	EN		OGR 3, FDS 2, ADE 2, F 1, CST 1	OGR 3, FDS 2, ADE 2, CST 1, MW 1, F 1, CC 1, CHE 1
		SF	EN	EN–CR	A1, CD1	–	EN			
		NF								
P02	**Rock meadows**	F	CR		A3	–	EN	3	OGR 3, EP 2, CST 2, EXT 2, F 1	EP 3, OGR 3, CST 2, ADE 2, F 1, EXT 1
		SF	CR		A3	–	EN	3		
		NF								
P02.01	Calcareous rock meadows	F	CR		A1, A3	–	CR		EXT 3, OGR 3, EP 2, CST 2, ADE 2, F 1	OGR 3, CST 2, F 2, EP 2, ADE 2, EXT 1
		SF	CR		A1, A3	–	CR			
		NF								
P02.02	Acidic rock meadows	F	CR		A3	–	EN	3	OGR 3, EP 2, F 1, CST 1, ADE 1	OGR 3, EP 2, F 2, ADE 2, CST 1
		SF	CR		A3	–	EN	3		
		NF								
P03	**Dry meadows**	F	CR		A1, A3	–	CR		OGR 3, AGCL 3, EP 2, F 2, CST 1, EXT 1, ADE 1	OGR 3, EP 2, CST 2, F 1, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P03.01	Calcareous dry meadows	F	CR		A1	–	CR		OGR 3, F 2, AGCL 2, EXT 2, EP 1, CST 1, ADE 1	OGR 3, F 2, CST 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF								
P03.02	Acidic low-herb-rich dry meadows	F	CR		A1	–	CR		OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1	OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF	DD		A1–A3, B1–B2, CD1–CD3	?	DD			
P03.03	Dwarf-shrub-rich dry meadows	F	CR		A1	–	CR		OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1	OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF	CR		A1	–	CR			
P03.04	*Avenula pubescens* dry meadows	F	CR		A1	–	CR		OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1	OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF								
P03.05	Grass-rich dry meadows	F	CR		A1	–	CR		OGR 3, EP 2, AGCL 2, F 1, ADE 1	OGR 3, EP 2, CST 1, F 1, AGCL 1, ADE 1
		SF	CR		A1	–	CR			
		NF	CR		A1	–	CR			
P04	**Mesic meadows**	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, EP 2, F 2, IAS 2, CST 2, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P04.01	Low-herb mesic meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, EP 2, F 2, IAS 2, CST 2, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P04.02	Tall-herb mesic meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, EP 2, F 2, IAS 2, CST 2, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P04.03	Graminoid mesic meadows	F	CR		A1, A3	=	EN	3	AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, F 2, EP 2, AGCL 1, IAS 1, CST 1, ADE 1
		SF	CR		A1, A3	=	EN	3		
		NF	CR		A1, A3	=	CR			

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
P05	**Moist meadows**	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1, CST 1	OGR 3, AGCL 2, DR 1, F 1, EP 1, CST 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P05.01	Calcareous moist meadows	F	CR		A1	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1, CST 1	OGR 3, AGCL 2, DR 1, F 1, EP 1, CST 1
		SF	CR		A1	–	CR			
		NF								
P05.02	Herb-rich moist meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1, CST 1	OGR 3, AGCL 2, DR 1, F 1, EP 1, CST 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P05.03	Grass-rich moist meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1	OGR 3, DR 2, EP 2, F 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P06	**Freshwater meadows**	F	CR		A1, A3	–	EN	3	OGR 3, WEP 3, WHC 2, WBR 2, DR 2, CST 2, IAS 2, AGCL 1	OGR 3, R 2, WHC 2, DR 2, IAS 2
		SF	CR		A1, A3	–	EN	3		
		NF	CR		A1, A3	–	EN	3		
P06.01	*Eleocharis acicularis* freshwater meadows	F	CR		A1, A3	–	DD	2	OGR 3, WEP 3, WHC 2, WBR 2, DR 2, CST 2, IAS 2	OGR 3, CST 2, WHC 2, DR 2, IAS 2
		SF	CR		A1, A3	–	DD	2		
		NF	DD		A1–A3, B1–B2, CD1–CD3	?	DD			
P06.02	*Equisetum fluviatile-Schoenoplectus lacustris* freshwater meadows	F	CR		A1, A3	–	DD	2	OGR 3, WEP 3, WHC 2, IAS 2	OGR 3, WHC 2, IAS 2, CST 2
		SF	CR		A1, A3	–	DD	2		
		NF	CR		A1, A3	–	DD	2		
P06.03	Tall-sedge freshwater meadows	F	CR		A1, A3	–	EN	2	OGR 3, WEP 3, WHC 2, IAS 2	OGR 3, WHC 2, IAS 2, CST 2
		SF	CR		A1, A3	–	EN	2		
		NF	CR		A1, A3	–	VU	2		
P06.04	Low freshwater graminoid meadows	F	CR		A1, A3	–	CR		OGR 3, WEP 2, WHC 2, WBR 2, DR 2, CST 2, AGCL 1	OGR 3, CST 2, WHC 2, DR 2
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P06.05	Tall freshwater meadows	F	CR		A1, A3	=	EN	2	OGR 3, AGCL 2, DR 2, CST 2, IAS 2, WEP 1, WHC 1, WBR 1	OGR 3, DR 2, IAS 2, CST 1, WHC 1
		SF	CR		A1, A3	=	EN	2		
		NF	CR		A1, A3	=	VU	2		
P07	**Seashore meadows**	F	CR		A1, A3	–	CR		OGR 3, AGCL 3, WEP 2, WHC 2, DR 2, CST 1	OGR 3, WEP 2, WHC 2, DR 2, CC 2
		SF	CR		A1, A3	–	CR			
		NF								
P07.01	*Eleocharis parvula-E. acicularis* seashore meadows	F	CR	VU–CR	A1	–	DD	2	OGR 3, CC 2, WHC 1	OGR 3, WEP 2, WHC 1, CC 1
		SF	CR	VU–CR	A1	–	DD	2		
		NF								
P07.02	*Eleocharis palustris-Schoenoplectus tabernaemontani-Bolboschoenus maritimus* seashore meadows	F	CR		A1	–	DD	2, 5	OGR 2, WHC 1, DR 1	OGR 2, WHC 2, DR 2
		SF	CR		A1	–	DD	2, 5		
		NF								
P07.03	Tall-sedge seashore meadows	F	CR		A1	–	CR		OGR 3, WEP 2, WHC 1, DR 1	OGR 3, WEP 1, WHC 1, DR 1, CC 1
		SF	CR		A1	–	CR			
		NF								
P07.04	Low-graminoid seashore meadows	F	CR		A1	+	CR		OGR 3, WEP 2, WHC 2, DR 2, AGCL 2, CST 1	OGR 3, WEP 2, WHC 2, DR 2, CC 1
		SF	CR		A1	+	CR			
		NF								
P07.05	Tall seashore meadows	F	CR		A1	–	EN	5	OGR 3, WEP 2, DR 2, AGCL 2, WHC 1, CST 1	OGR 3, DR 2, CC 2, WEP 1, WHC 1
		SF	CR		A1	–	EN	5		
		NF								
P07.06	Salt patches	F	CR		A1	–	CR		OGR 3, WEP 2, DR 2, AGCL 2, WHC 1, CST 1	OGR 3, WEP 2, DR 2, WHC 1, CC 1
		SF	CR		A1	–	CR			
		NF								

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
P08	**Alluvial meadows**	F	CR		A1, A3	–	EN	3	WHC 3, WBR 3, OGR 3, AGCL 2, WEP 1	OGR 3, WBR 3, WHC 2, CC 2, WEP 1, AGCL 1
		SF	CR		A1, A3	–	EN	3		
		NF	CR		A1, A3	–	EN	3		
P08.01	*Equisetum fluviatile* alluvial meadows	F	CR		A1, A3	=	NT	3	WHC 3, WBR 3, WEP 1	WBR 3, WHC 2, CC 2, WEP 1
		SF	CR		A3	=	NT	3		
		NF	CR		A1, A3	=	NT	3		
P08.02	Tall-sedge alluvial meadows	F	CR		A1, A3	=	NT	3	WHC 3, WBR 3, AGCL 2, OGR 1, WEP 1	WBR 3, WHC 2, CC 2, WEP 1, AGCL 1, OGR 1
		SF	CR		A1, A3	=	NT	3		
		NF	CR		A1, A3	=	NT	3		
P08.03	Moist graminoid alluvial meadows	F	CR		A1, A3	=	VU	3	WHC 3, WBR 3, OGR 2, AGCL 1, WEP 1	WBR 3, WHC 2, OGR 2, CC 2, AGCL 1, WEP 1
		SF	CR		A3	=	VU	3		
		NF	CR		A1, A3	=	VU	3		
P08.04	Mesic graminoid alluvial meadows	F	CR		A1, A3	–	CR		WHC 3, WBR 3, OGR 3, AGCL 2	OGR 3, WBR 3, WHC 2, CC 2, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P08.05	Mesic tall-herb alluvial meadows	F	CR		A1, A3	–	CR		WHC 3, WBR 3, OGR 3, AGCL 2	OGR 3, WBR 3, WHC 2, CC 2, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P08.06	Dry low-herb alluvial meadows	F	CR		A1, A3	–	CR		WHC 3, WBR 3, OGR 3, AGCL 2	OGR 3, WBR 3, WHC 2, CC 2, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P09	**Fen meadows**	F	CR		A1, A3	–	CR		OGR 3, DR 2, F 1, PE 1, AGCL 1, WHC 1	OGR 3, DR 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P10	**Pollard meadows**	F	CR		A3	–	CR		AGCL 3, OGR 3, F 3, EP 2, ADE 1, CST 1	OGR 3, FTS 2, EP 2, ADE 2, CST 1, F 1
		SF	CR		A3	–	CR			
		NF								
P11	**Wooded pastures**	F	CR		A1, A3	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 2, FTS 2, CST 1	OGR 3, F 3, EP 3, FCWD 2, FTS 2, CST 1, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P11.01	Wooded pastures dominated by deciduous hardwood trees	F	CR		A1	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 3, FTS 2, ADE 2, CST 1	OGR 3, F 3, EP 3, FCWD 3, FTS 2, ADE 2, CST 1, AGCL 1
		SF	CR		A1	–	CR			
		NF								
P11.02	Wooded pastures dominated by deciduous trees	F	CR		A1	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 3, FTS 2, ADE 2, CST 1	OGR 3, F 3, EP 3, FCWD 3, FTS 2, CST 1, AGCL 1, ADE 1
		SF	CR		A1	–	CR			
		NF	DD		A1–A3, B1, B2	–	CR	3		
P11.03	Wooded pastures with deciduous and coniferous trees	F	CR		A1	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 3, FTS 2, CST 1	OGR 3, F 3, EP 3, FCWD 3, FTS 2, CST 1, AGCL 1
		SF	CR		A1	–	CR			
		NF	DD		A1–A3, B1, B2	–	CR	3		
P11.04	Wooded pastures dominated by coniferous trees	F	CR		A1	?	CR		F 3, AGCL 3, OGR 3, EP 2	OGR 3, F 3, FCWD 2, EP 2, CST 1, AGCL 1
		SF	CR		A1	?	CR			
		NF	DD		A1–A3, B1, B2	?	CR	3		
P12	**Grazed woodlands**	F	CR		A1, A3	?	EN	3	F 3, OGR 3, FTS 2, AGCL 2, EP 2, FOG 1	OGR 3, F 3, FTS 2, EP 2, FCWD 2, FOG 1
		SF	CR		A1, A3	?	EN	3		
		NF	CR		A1, A3	?	CR			
P12.01	Grazed woodlands dominated by deciduous trees	F	CR		A1, A3	?	CR		F 3, OGR 3, AGCL 2, EP 2, FTS 2, FOG 1	OGR 3, F 3, FTS 3, EP 2, FOG 2, FCWD 1
		SF	CR		A1, A3	?	CR			
		NF	CR		A1	?	CR			
P12.02	Grazed woodlands with deciduous and coniferous trees	F	CR		A1, A3	?	CR		F 3, OGR 3, AGCL 2, EP 2, FTS 2, FOG 1	OGR 3, F 3, FTS 2, FCWD 2, EP 2, FOG 1
		SF	CR		A1, A3	?	CR			
		NF	CR		A1	?	CR			
P12.03	Grazed woodlands dominated by coniferous trees	F	CR		A1, A3	?	EN	3	F 3, OGR 3, EP 2, AGCL 1, FOG 1	OGR 3, F 3, FCWD 2, EP 2, FOG 1
		SF	CR		A1, A3	?	EN	3		
		NF	CR		A1	?	CR			

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Assessments based on criterion B, that is, examination of the geographic distribution, as a general rule produced lower Red List categories than assessments based on quantitative changes. This is due to the previous common occurrence of seminatural grasslands and wooded pastures: occurrences are still found over an extensive area although they are small and their total combined area has decreased considerably.

Quantitative decline

Significant quantitative reductions in seminatural grasslands and wooded pastures already took place for the majority of these habitat types in the early 1900s. The quantitative decline began as early as in the 1880s, which is when agricultural administration was strengthened, training for increased farming efficiency was increased and more extensive clearing of meadows for agriculture began. It is estimated that at that point there were around 1.6 million hectares of meadows (Soininen 1974). The area covered by meadows decreased by more than half in the 1880–1920 period while at the same time the area of arable land more than doubled (Figure 4.54). The number of mesic meadows in particular decreased strongly in the late 1800s due to clearing for agriculture, and their number fell continuously throughout the 1900s. The reduction in the number of dry meadows in the late 1800s and early 1900s was probably slower than that in the number of mesic meadows. Being oligotrophic, dry meadows were less commonly cleared for agriculture and it appears that the majority of them were not afforested until later. The decline of freshwater meadows appears to have started already at an early stage.

The reduction in seminatural grasslands continued throughout the first half of the 1900s and accelerated further after the 1950s. That is when the use of artificial fertilisers increased significantly, agriculture was mechanised and meadows were cleared for grain and grass crops. In the late 1960s, Finnish agriculture was still dominated by small farms, and meadows as well as natural pastures remained quite common (Pykälä 2001). The reduction in grazed woodlands and wooded pastures had already been strong before the 1950s but not as steep as that of most meadow types. The most labour-intensive traditional methods such as pollarding to obtain livestock fodder and spring cleaning of pollard meadows as well as controlled burning of heaths were almost entirely abandoned as early as in the 1940s and 1950s.

Since the 1960s, Finland's agricultural policy required farm sizes to be increased and new technology to be adopted, which accelerated the disappearance of small farms. Following the introduction of mechanical milking, it was preferred to keep cows close to the farm complex and only young stock were left grazing on pastures further away. Once cultivated grass became common, mowed meadows were gradually phased out or turned into pastures. A lot of meadows were also cleared for crop fields, afforested or left unused to overgrow. The decrease in the number of livestock farms and the depopulation of rural areas due to migration to southern Finnish cities and Sweden in the 1960s and 1970s contributed to the reduction in the quantity of all seminatural grasslands and wooded pastures. This coincided with the start of the specialisation of farms into a single production line, with the size of farms increasing and the number of livestock farms decreasing. The traditional use of meadows, wooded pastures and grazed woodlands continued the longest in remote areas.

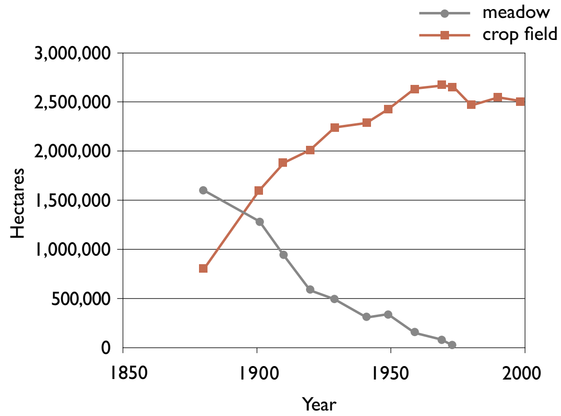


Figure 4.54. Development of the area covered by meadows and crop fields since 1880 according to agricultural statistics and Soininen (1974).

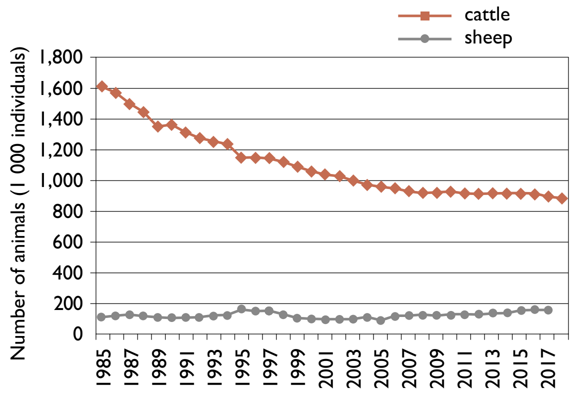


Figure 4.55. Development of the number of cattle and sheep (Natural Resources Institute Finland 2017).

The main reason for the reduction in the quantity of grazed woodlands has been the transition of forests from mixed agricultural and forestry use to exclusive forestry use. Grazing livestock has been regarded as reducing forest yields. From as early as since the first decades of the 1900s, silvicultural advice strongly emphasised the harm caused by woodland grazing to wood production. Although reduced, grazing on woodland pastures remained common until the 1950s and 1960s. Statistics from 1965 still list around 1.36 million hectares of grazed woodlands, but their number plummeted in the 1960s and 1970s. The reduction in seashore meadows had been slight before the 1950s but was strong after this period. The quantitative reduction in freshwater meadows has also accelerated since the 1950s, although reduction had already taken place before that. As regards seashore meadows, the reduction has levelled out over the past ten years as their use as pastures has been revived.

Agricultural development that is unfavourable to seminatural grasslands and wooded pastures is still ongoing. Impacts of the European Union's common agricultural policy are leading into increases in farm size, decreases in the number of farms, cessation of small farm production, growing efficiency requirements and more and more advanced specialisation. On the other hand, joining the European Union brought Finland access to specific forms of agri-environmental subsidy that began to significantly advance the preservation of seminatural grasslands and wooded pastures from 1995 onwards. Today, the five-year environmental agreements on the management of biodiversity and landscapes in agricultural habitats included in the agri-environmental subsidy scheme are by far the most important source of funding for the management of seminatural grasslands and wooded pastures. This covers the management of around 98% of the current managed area of around 30,000 hectares. In spite of this, the number of livestock holdings and grazing livestock (Figure 4.55) and, consequently, the area of seminatural grasslands and wooded pastures have decreased all the time, and this trend is projected to continue further regardless of the slight levelling out that has taken place. General changes in agricultural policy reduce the effectiveness of measures aimed at conserving seminatural grasslands and wooded pastures. These habitat types are dependent particularly on the general profitability of cattle and sheep farming in Finland. The number of mowed meadows has continued its decline, and mowed meadows are nowadays extremely rare in Finland.

Meadows and wooded pastures have been subjected to increasing volumes of construction (roads, housing, production buildings and hydraulic construction). Likewise construction of, for example, holiday homes, which underwent strong growth in Finland starting from the 1970s, has destroyed rock meadows and dry meadows in particular. Dredging related to coastal construction has deteriorated seashore meadows of the land uplift coast in particular. Hydraulic construction in turn has destroyed shore and alluvial meadow habitat types.

The quantitative reduction is presumed to continue further among most of the meadow-like habitat type groups of seminatural grasslands. The quantitative trend of seashore meadows has taken a positive turn as the area managed under environmental agreements has increased. The rate of quantitative reduction is anticipated to slow down for a few seminatural habitat types such as wooded ones. The trend projected for the various habitat types within some habitat type groups is somewhat different. This is partly due to seminatural grassland and wooded pasture habitat types potentially changing into other types of habitat. For example, low-herb mesic meadows are decreasing in number partly because they are becoming classified as graminoid mesic meadows following the discontinuation of management and due to the impacts of eutrophication.

Decline in quality

In line with the quantitative changes, the examination of qualitative changes puts most seminatural grassland and wooded pasture habitat types in the threatened categories. The decline in the quality of meadows, wooded pastures and grazed woodlands has taken place over a considerably shorter period time than their quantitative reduction. The quality of most of these habitat types has only declined significantly after the 1950s. Habitat types whose quality had declined as early as at the beginning of the 1900s or earlier include at least pollard meadows, wooded pastures dominated by hardwood deciduous trees[1], mesic and moist meadows, fen meadows and, among rock meadows, especially calcareous rock meadows. There is, however, very little knowledge of the earliest quality changes. Data on the trends of change and on their timing for individual seminatural grassland and wooded pasture habitat types is deficient. There is also an absence of more specific data on habitat types' quality or breakdown into representativeness categories, and only estimates can be provided concerning these.

As regards heaths and freshwater meadows, their qualitative and quantitative examinations produced the same result at the habitat type group level. At the group level, focusing the examination exclusively on qualitative decline rather than on quantitative reduction would result in a drop of one IUCN Red List category in, for example, seashore meadows, alluvial meadows and wooded pastures.

The decline in quality is expected to continue for most seminatural grassland and grazed woodland habitat types. This is especially due to the continuing overgrowth process and the slow rate of inclusion of sites within management measures as well as to insufficient guidelines on the implementation of management. The key factor is the scarcity of resources for organising management guidance, advice and regional coordination of matters related to seminatural grasslands and wooded pastures.

4.7.4 Trends

The short-term trend of 76% of seminatural grasslands and wooded pastures was regarded as declining and of 12% as stable in the nationwide results. Habitat types assessed as stable include tall freshwater meadows, whose occurrences are preserved as vegetation of the succession stage between less grazed areas and native vegetation more successfully than occurrences of other shore meadow habitat types. The vegetation of some of the sub-types of alluvial meadows, too, stays open due to the impacts of ice, floodwater and sedimentation. An improving trend was only seen for one seminatural grassland habitat type – low graminoid seashore meadows – whose area has started to grow and whose quality has begun to improve especially in North Ostrobothnia thanks to the increased scope and efficiency of management. The trend for around 10% of the habitat types, including grazed woodlands, could not be assessed.

1 Common oak (*Quercus robur*), common ash (*Fraxinus excelsior*), small-leaved lime (*Tilia cordata*), Norway maple (*Acer platanoides*), wych elm (*Ulmus glabra*), also hazel (*Corylus avellana*).

4.7.5
Reasons for becoming threatened and threat factors

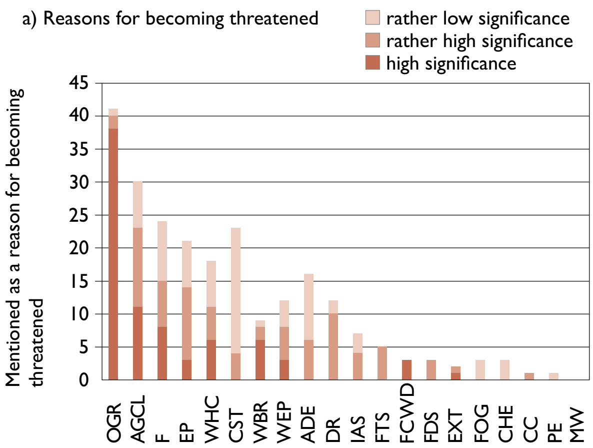
There are several reasons for meadows, wooded pastures and grazed woodland habitat types becoming threatened (Figure 4.56a). In addition to changes in agriculture, these are also related to other societal changes. Traditional management has ceased and numerous new measures have been introduced to replace old land uses, and these have either directly reduced habitat type occurrences or eliminated processes that maintain habitat types (such as flooding). The intensity of the impact of the reasons has also varied over time. The reasons for seminatural grassland and wooded pastures habitat types becoming threatened differ to some extent from the threats faced by them in the future. Most of the factors causing the loss and quality decline of these habitat types are still the same today, but their significance has changed compared with the past.

The three most significant reasons for seminatural grassland and wooded pasture habitat types becoming threatened are clearing for agriculture, afforestation and overgrowth following the discontinuation of grazing and mowing. Particularly significant reasons as regards seminatural grasslands located on shores and in coastal areas also comprise hydraulic construction, nearshore dredging and eutrophication of water bodies. There is, however, a great deal of variation between habitat types in the reasons for them becoming threatened, and the group of significant reasons contributing to their development is typically quite extensive. There are also individual habitat types where the significant reasons for them becoming threatened differ from those of the others, such as lime excavation for calcareous rock meadows.

Clearing for agriculture (AGCL) has been a significant reason resulting in habitat types becoming threatened. It has caused the large-scale destruction of mesic and moist meadows in particular but also of wooded pastures dominated by hardwood deciduous trees. Turning meadows into farmed fields has been the fate of most seminatural grasslands and caused the biggest collapse in the size of the area covered by them. In particular, open meadows located close to farm complexes have been cleared for use as arable land. Clearing for agriculture decreased in the 1960s–1980s period but has increased again to some extent after Finland joined the European Union. This poses a continuing threat to mesic and moist meadows, the drier types of alluvial meadows and wooded pastures.

Forest treatment applying commercial forest management principles (F) is the main reason for most wooded pastures and grazed woodlands becoming threatened. Reduction in deadwood, felling of trees as well as the trend towards increasingly even-aged and dense tree stands have had negative impacts on species diversity in wooded pastures and grazed woodlands. Afforestation has also caused major destruction of rock meadows, dry meadows and mesic meadows.

The discontinuation of traditional mowing and grazing as well as controlled burning and other management measures (OGR) is the most important reason for heaths, acidic rock meadows, dry meadows, freshwater and seashore meadows, fen meadows and pollard meadows becoming threatened. Also the prevention of forest fires has probably accelerated processes such as the overgrowth of rock meadows. When abandoned, seminatural grasslands and grazed woodlands become overgrown and colonised by forests. Increased shading by peripheral trees also changes the species composition of seminatural grasslands. Overgrowth is a process that destroys these habitat types gradually and results from the discontinuation of the use and management – or from the insufficient management – of an area and is accelerated by eutrophication or afforestation. The rate of overgrowth is affected by the nutrient and moisture levels of the soil in the area. Initially, the overgrowth rate is usually slow,



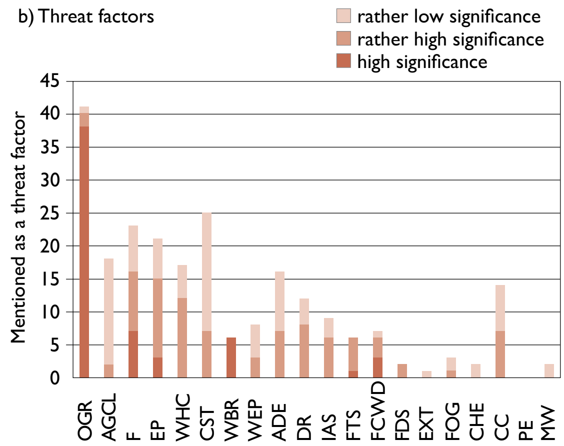


Figure 4.56. Reasons for becoming threatened (a) and threat factors (b) of seminatural grassland and wooded pasture habitat types. The reasons for habitat types becoming threatened are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types.

and this is when the area's values can mostly be restored by re-commencing management. Once overgrowth has reached more advanced stages, sites that were originally open already feature numerous trees and shrubs, making it difficult to identify seminatural grasslands and wooded pastures. In sites that have been reduced in size and that have in part become closed, the rate of overgrowth is high. The significance of overgrowth as a threat has increased. However, heavily overgrown areas can also be restored if species characteristic of the habitat type have been preserved in the site or in its immediate vicinity.

Overgrowth caused by the discontinuation of grazing and mowing is clearly the most important future threat for meadows, wooded pastures and grazed woodlands (Figure 4.56b). Overgrowth was regarded as the most significant future threat for most of the habitat types. Also regarded as some of the most significant threats are eutrophication, construction and afforestation. The clearest difference in the threats compared with the reasons for these habitat types becoming threatened is the reduction in the threat posed by clearing for agriculture.

The **construction** (CST) of roads, housing, holiday homes, outbuildings and industrial buildings, etc., has caused widespread destruction of meadows and wooded pastures. Construction has taken place in areas such as around farm complexes – with holiday homes having been built especially in coastal areas and on shores and rock outcrops (rock meadows) – and in conjunction with urban growth. So far, the preservation of seminatural grasslands and grazed woodlands has not been taken sufficiently into account in statutory land use planning. With the exception of certain habitat types, construction has played a less significant role in habitat types becoming threatened, but its significance as a future threat is high. Construction and urban sprawl also involve excessive mechanical wear of terrain, which can be seen as a threat for habitat types such as heaths, dry meadows and rock meadows.

Discontinuation of traditional use, eutrophication of water bodies and hydraulic construction are also the most important reasons for freshwater meadow types becoming threatened and also play a significant role as regards seashores. **Eutrophication of water bodies** (WEP) accelerates reedbed expansion and plant mass accumulation, which further increases the eutrophication of water and soil. Overgrowth caused by reedbed expansion has been a significant reason for seminatural grasslands becoming threatened and still continues at a high rate. Eutrophication of water bodies will continue to pose a threat to the representativeness of shore meadow habitat types and reduce their quantity. **Water level regulation** (WBR) is not only a threat but also a reason for many freshwater meadow and alluvial meadow habitat types becoming threatened. **Hydraulic construction** (WHC) has destroyed alluvial meadows and freshwater meadows in particular and caused the loss and fragmentation of seashore meadows, too. Damming of rivers, prevention of floods, construction of harbours, boating channels, landing stages and levees as well as nearshore dredging have been and are going to be harmful to seminatural grasslands on shores.

Ditch drainage (DR) has dried moist meadows, freshwater and seashore meadows and fen meadows and altered their habitat types. These habitat types have also been affected by drainage carried out further away. The higher rate of solids in water caused by peat production and ditch drainage has had an adverse effect on alluvial meadows.

Extractive activities (EXT) have reduced the number of calcareous habitat types in particular. Lime excavation is the most significant reason for the quantitative reduction in calcareous rock meadows. Excavation is not, however, their biggest threat in the future as construction, afforestation and overgrowth have become the most significant threat factors faced. In Lapland, there is pressure towards increases in mining industry, and new mines may also pose a threat to many seminatural grassland and wooded pasture sites.

The threat caused by **eutrophication** (EP) is projected to grow in the future. Individual meadows or wooded pastures whose size has decreased are more vulnerable to eutrophication resulting from incorrect grazing practices. Changes in grazing practices, such as incorporating seminatural grasslands or wooded pastures into grass pastures, and providing supplementary feed and minerals on pastures, introduce nutrients to these habitat types and therefore accelerate their overgrowth. The plant mass remaining on the site following the discontinuation of management eutrophicates soil and accelerates the rate of overgrowth. Airborne deposition of eutrophying substances also has a negative impact on seminatural grassland and wooded pasture species. Eutrophying fallout is assessed to have contributed towards rock meadows, dry meadows and mesic meadows having become threatened and is regarded as a considerable threat in the future, too. Most seminatural grassland and wooded pasture habitat types are highly sensitive to eutrophication and the resulting changes in species composition.

Mowing and grass collection being replaced by grazing has changed the quality of traditional mowed meadows. Grazing does not, for example, maintain the characteristic features of low-herb mesic meadows or seashore meadows in the same way as mowing. The species composition changes after a transition from mowing to grazing. Mowing unfortunately takes place to a very limited extent these days, with only around 1% of meadows estimated to be managed by mowing. Habitat types requiring labour-intensive management are currently highly threatened as access to funding is decreasing. In addition to mowed meadows, labour-intensive management is required especially by pollard meadows and fen meadows.

The spread of **invasive alien species** (IAS) such as the large-leaved lupin (*Lupinus polyphyllus*), the dwarf serviceberry (*Amelanchier spicata*) and several ornamental plants is already a major problem in mesic meadows. The dispersal of the reed sweetgrass (*Glyceria maxima*) in freshwater meadows has already resulted in losses of these habitat types and the impacts are assumed to grow in the future. The rugosa rose (*Rosa rugosa*) is expected to spread further in seashore meadows and to soon reach the coasts of the Kvarken and Bothnian Bay, too. Its dispersal rate is also expected to accelerate further in southern coastal areas despite the prevention measures taken.

Peat extraction (PE) used to reduce the quantity of fen meadows. Increasing use of bioenergy in the future may pose a significant threat to many seminatural grasslands and grazed woodlands if it leads into these habitat types being cleared for agriculture, their afforestation or fertilisation, wooded habitat types being felled or biomass-producing plants being planted in these habitat types.

The impacts of **climate change** (CC) are difficult to assess, but the preservation of seashore meadows where salinity levels and the volume and erosion impact of ice are projected to decrease will be affected the most. Ice erosion will also decrease in alluvial meadows and freshwater meadows, and the consequences can already be seen in sites such as meadows by the River Tana as acceleration of the overgrowth rate. Global warming is accelerating the rate of growth and the release of nutrients. Especially in unmanaged sites, this has an accelerating effect on processes such as the overgrowth of dry meadows and rock meadows. Increases in atmospheric carbon dioxide levels also have a eutrophicating effect on vegetation and therefore accelerate overgrowth. Rising ozone levels in the atmosphere are projected to have a negative impact especially on many meadow species.

Generally speaking it can be said that the management of seminatural grasslands and wooded pastures is currently fully reliant on the agri-environmental subsidy scheme and on cattle and sheep farms using natural pastures and carrying out landscape management. Changes in agricultural policy and in demand for agricultural products have a direct impact on the management of seminatural grasslands and wooded pastures. Agricultural policy is highly unpredictable over the long term and future trends are therefore difficult to assess. The trend seen over the past couple of years in the managed area of seminatural grasslands and wooded pastures has, however, been generally positive thanks to the improvements made to the Rural Development Programme 2014–2020. The continuous reduction in the number of livestock farms is a major threat to the preservation of seminatural grasslands and wooded pastures. In many places there is room for improvement in management quality. Aspects such as grazing pressure are too often too weak, resulting in the positive ecological impacts of management being lower than they could be.

IUCN method 2018 \ National method 2008	LC	NT	VU	EN	CR	DD	NE
LC							
NT							
VU							
EN				1	1		
CR		2	1	6	27	4	
DD							

Figure 4.57. Red List categories of seminatural grassland and wooded pasture habitat types for the whole of Finland using IUCN methodology in 2018 and their classification based on the national method in 2008. The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassifications.

4.7.6
Comparison with previous assessment

As the threat status assessment method changed from the national method to IUCN methodology, the results of the first and second assessment are not directly comparable (cf. Schulman et al. 2008). In the majority of the assessments, the Red List category assigned was still the same, however (Figure 4.57). Habitat types classified in the previous threat status assessment at the nationwide level as Data Deficient (DD), Near Threatened (NT) or Vulnerable (VU) are classified as Critically Endangered (CR) in the current assessment. An exception to this is the downlisting of graminoid heaths from CR to Endangered (EN).

It should be noted that not a single reclassification was regarded as being attributable to a genuine change in the state of the habitat type compared with the previous assessment. Instead, changes of category were in most cases due to a change in method and in some cases also to an increase in knowledge or a change in habitat type classification (see Table 4.8).

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4.8

Fell habitats

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4.8.1
Threat status of fell habitat types

IUCN Red List categories

The 56 examined assessment units are broken down into habitat type groups in such a way that mountain birch forests, mountain heaths as well as snowbeds and snow patches each contain 9 habitat types of the lowest hierarchical level of the classification. There are 8 types of mountain rock outcrops and boulder fields and 4 types of mountain meadows. The mountain forest with aspen, pine or spruce as well as mountain heath scrub groups both contain 3 habitat types and the low-graminoid mountain heath as well as patterned ground and solifluction sheet groups both contain 2 types. Frost-influenced heaths, and mountain dunes and deflation basins, are at the same time both habitat type-level and group-level units. The threat status of mountain birch forests, mountain heaths and snowbeds was also assessed at the group level. In addition, 2 fell habitat complexes were assessed: fell canyons as well as fell gorges and channels. Fell habitat types only occur in Northern Finland and therefore the results for Northern Finland and for the whole country are identical. Unless otherwise specified, the overall results of the assessment and the percentages of threatened habitat types are calculated for the 53 assessment units at the lowest hierarchical level of the classification, of which 2 are habitat complexes and the rest habitat types. These are referred to as 'fell habitat types' or 'habitat types'.

Of the 53 assessed fell habitat types, 20 habitat types (38%) were assessed as being threatened (VU, EN or CR) (Figure 4.58a). The threatened habitat types cover approximately as high a percentage – 40% (around 515,000 ha) – of the total area of fell habitat types, too (Figure 4.58b). Of the remaining 33 habitat types, 24% or 13 habitat types were classified as Near Threatened (NT). The total combined area of NT habitat types – 704,000 ha – accounts for more than half (54%) of the total area of fell habitat types. Altogether 20 fell habitat types were classified as Least Concern (LC), accounting for 38% of the number of assessed fell habitat types but only 6% (83,000 ha) of their total area (Figure 4.58).

Habitat types assessed as threatened comprised all types of snowbeds and snow patches, frost-influenced heaths, the majority of mountain birch forests and

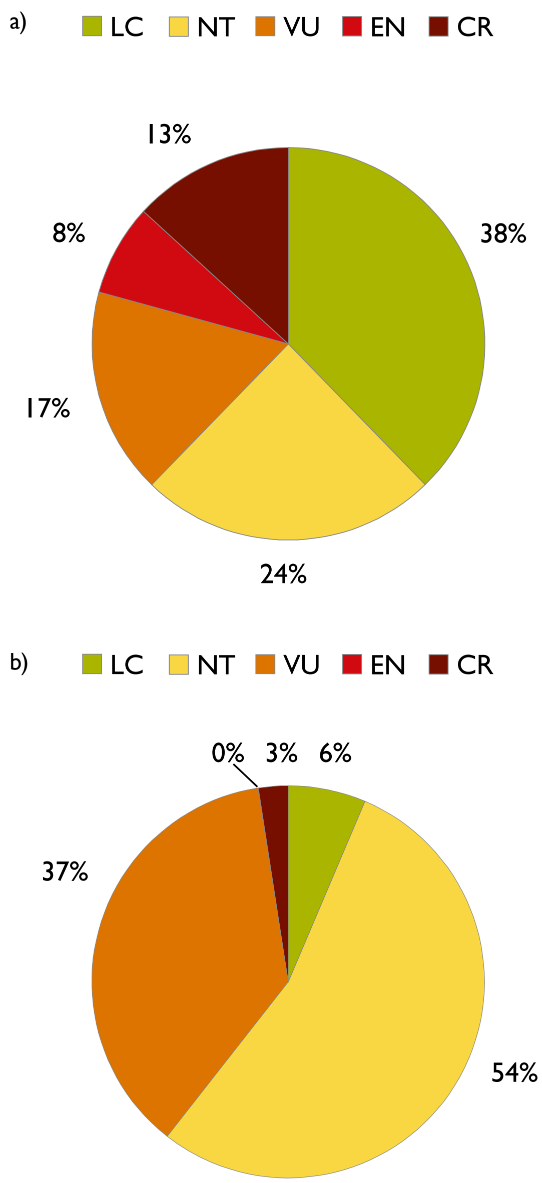


Figure 4.58. Breakdown of fell habitat types into IUCN Red List categories on the basis of a) the number of habitat types (53 types) and b) total area (1.3 million ha). The percentages were calculated on the basis of the lowest hierarchical level of the classification, so the figures do not include group-level assessments.

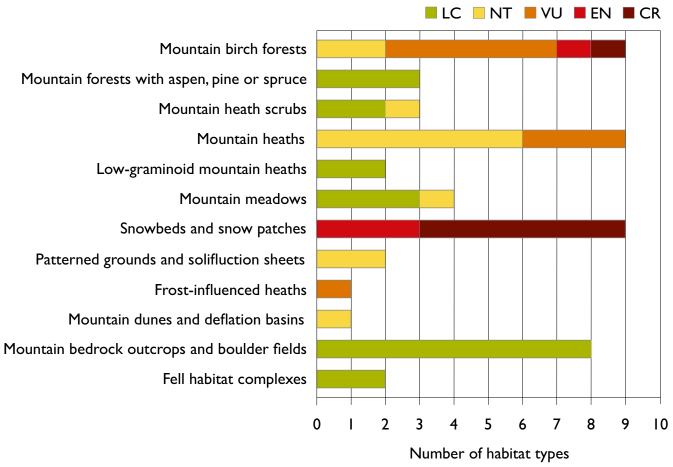


Figure 4.59. Breakdown of fell habitat types into IUCN Red List categories by main group of fell habitats (53 types).

part of mountain heaths (Figure 4.59). Of the total of 53 fell habitat types, 13% or 7 habitat types were assessed as Critically Endangered (CR): *Empetrum-Lichenes* mountain birch forests, snow patches and 5 snowbed types (oligotrophic *Salix herbacea* snowbeds, oligotrophic low-graminoid snowbeds, oligotrophic low-herb snowbeds, oligotrophic bryophyte-rich snowbeds and eutrophic bryophyte-rich snowbeds) (Table 4.9). The total combined area of these rather small-sized habitat types is 34,000 hectares or only 3% of the total area of fell habitat types (Figure 4.58b). The most significant reason for all of them becoming threatened is climate change, except in the case of *Empetrum-Lichenes* mountain birch forests, for which the most significant reason is the combined effect of climate change and grazing pressure.

Altogether 4 habitat types or 8% of the total were assessed as Endangered (EN): *Empetrum* mountain birch forests and 3 snowbed types (oligotrophic *Ranunculus glacialis* snowbeds, eutrophic heath-like snowbeds and eutrophic low-herb snowbeds) (Figures 4.58 and 4.59, Table 4.9). These very small-sized habitat types together cover 620 hectares or only 0.05% of the total area of fell habitat types. The most significant reason for snowbed types becoming threatened is climate change and for *Empetrum* mountain birch forests the combined effect of climate change and grazing pressure.

The 9 habitat types (17% of the total number of fell habitat types) that were classified as Vulnerable (VU) cover 37% (480,000 ha) of the total area of fell habitat types (Figure 4.58). Assessed as VU were frost-influenced heaths, 5 mountain birch forest types (*Empetrum-Lichenes-Pleurozium* mountain birch forests, *Empetrum-Myrtillus* mountain birch forests, *Cornus-Empetrum-Myrtillus* mountain birch forests, *Cornus-Myrtillus* mountain birch forests and tall-herb mountain birch forests) and 3 mountain heath types (wind-exposed mountain heaths, *Calluna* mountain heaths and non-calcareous *Dryas octopetala* mountain heaths) (Figure 4.59, Table 4.9). The most significant reason for frost-influenced heaths, *Calluna* mountain heaths and non-calcareous *Dryas octopetala* mountain heaths becoming threatened is climate change, for wind-exposed mountain heaths grazing pressure and for mountain birch forests the combined effect of climate change and grazing pressure.

Altogether 13 habitat types were classified as Near Threatened (NT): part of mountain birch forests, the majority of mountain heath types, mountain birch scrubs, tall-herb mountain meadows, pattered grounds, solifluction sheets, and mountain dune and deflation areas (Figure 4.59, Table 4.9). Some of these are large in size and common (such as *Empetrum* mountain heaths), but the NT habitat types also include a group of small-sized and rare habitat types (such as fern-rich mountain birch forests, *Cassiope tetragona* mountain heaths and tall-herb mountain meadows). The reasons for these habitat types becoming threatened comprise grazing pressure, climate change and their combined effect; however, for most NT mountain heaths climate change and grazing pressure mitigate each other's effects.

Fell habitat types classified as Least Concern (LC) comprise mountain forests with aspen, pine or spruce, low-graminoid mountain heaths, mountain rock outcrops and boulder fields, fell habitat complexes and the majority of heath scrubs and mountain meadows (Figure 4.59, Table 4.9).

Group-level assessments were conducted for mountain birch forests, mountain heaths and snowbeds. Mountain heaths were classified as Near Threatened (NT), which corresponds to the result of the previous assessment (see Norokorpi et al. 2008). Mountain birch forests were assessed as Vulnerable (VU) and snowbeds as Critically Endangered (CR), whereas in the previous assessment both were classified as NT (Norokorpi et al. 2008). The most significant reasons for the mountain birch forest group becoming threatened are the combined effects of climate change and grazing pressure, for mountain heaths grazing pressure and climate change and for snowbeds climate change. The group level habitat types of mountain birch forests and mountain heaths make up a major proportion (89%) of the total area covered by fell habitat types.

Trends

Of the fell habitat types, the near-term trend for 22 habitat types (41%) was assessed as stable, for 28 types (53%) as declining and for 3 types (6%) as improving. Those assessed as undergoing a declining trend comprised all mountain birch forests as well as mountain birch scrubs due to climate change and the continuing intensive summer grazing pressure, and the same applies to some mountain heaths. Climate change was regarded as impairing the trend for snowbeds and snow patches, mountain dunes and deflation basins as well as habitat types dependent on ground frost. Habitat types assessed as undergoing an improving trend were mountain forests with aspen, pine or spruce as climate change promotes the expansion of the aspen (*Populus tremula*), Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*).

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Table 4.9. Results of the threat status assessment of fell habitat types: IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category, and reasons for becoming threatened and threat factors.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change, 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
T	**Fell habitats**								
T01	**Mountain birch forests**	VU	VU–EN	A2a, CD1, CD3	–	NT	3, 1, 2	GP & CC 3, GP 3, CC 2	GP & CC 3, GP 3, CC 2, MW 1, CST 1
T01.01	Dry and dryish mountain birch forests								
T01.01.01	*Empetrum-Lichenes* mountain birch forests	CR		D1	–	VU	3, 1, 2	GP & CC 3, GP 3, CC 2	GP & CC 3, GP 3, CC 2
T01.01.02	*Empetrum-Lichenes-Pleurozium* mountain birch forests	VU	NT–EN	A2a, CD1, CD3	–	NT	3, 1, 2	GP & CC 3, GP 3, CC 2	GP & CC 3, GP 3, CC 2
T01.01.03	*Empetrum-Myrtillus* mountain birch forests	VU	VU–EN	A2a, CD1, CD3	–	NT	3, 1, 2	GP & CC 3, GP 2, CC 2	GP & CC 3, GP 2, CC 2
T01.02	Mesic mountain birch forests								
T01.02.01	*Empetrum* mountain birch forests	EN		B1,2a(i,ii,iii)bc	–	VU	3, 1, 2	GP & CC 3, CC 2, GP 2	GP & CC 3, CC 2, GP 2, CST 2, MW 1
T01.02.02	*Cornus-Empetrum-Myrtillus* mountain birch forests	VU		B1,2a(iii)bc, CD1, CD2a	–	NT	3, 1, 2	GP & CC 2, GP 2, CC 1	GP & CC 2, GP 2, CC 1, MW 1, CST 1
T01.02.03	*Cornus-Myrtillus* mountain birch forests	VU	VU–EN	B1,2a(iii)bc, CD1, CD2a	–	NT	3, 1, 2	GP & CC 2, GP 2, CC 1	GP & CC 2, GP 2, CC 1, MW 1, CST 1
T01.03	Herb-rich mountain birch forests								
T01.03.01	Low-herb mountain birch forests	NT	NT–VU	A2a, CD1, CD3	–	NT		GP & CC 2, GP 1, CC 1	GP & CC 2, GP 1, CC 1
T01.03.02	Tall-herb mountain birch forests	VU		B1,2a(i,ii,iii)bc, CD1, CD2a	–	NT	3, 1, 2	GP & CC 2, CC 1, GP 1	GP & CC 2, CC 1, GP 1, MW 1, CST 1
T01.03.03	Fern-rich mountain birch forests	NT		B1,2b, CD2a	–	NT		GP & CC 1–2, CC 1, GP 1	GP & CC 1–2, CC 1, GP 1
T02	**Mountain forests with aspen, pine or spruce**								
T02.01	Mountain forests with aspen	LC			+		4		GP 1
T02.02	Mountain forests with pine	LC			+		4		GP 1
T02.03	Mountain forests with spruce	LC			+		4		GP 1
T03	**Mountain heath scrubs**								
T03.01	Mountain *Salix* scrubs	LC			=	NT	2, 3		GP 2, GP & CC 1
T03.02	Mountain *Juniperus communis* scrubs	LC			=	LC			
T03.03	Mountain birch scrubs	NT		A1, A2a	–	NT		GP 2, GP & CC 2, CC 1	GP 2, GP & CC 2, CC 1
T04	**Mountain heaths**	NT	NT–VU	A2a, CD1, CD3	–	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.01	Wind-exposed mountain heaths	VU		CD1	–	VU		GP 3	GP 3, MW 1
T04.02	*Empetrum* mountain heaths	NT	NT–VU	A2a, CD1, CD3	–	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.03	*Betula nana* mountain heaths	NT	NT–VU	CD1, CD3	–	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.04	*Myrtillus* mountain heaths	NT		CD1–CD3	=	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.05	*Phyllodoce caerulea* mountain heaths	NT		CD1–CD3	=	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.06	*Calluna* mountain heaths	VU		CD2a	–	VU		CC 3, GP 1, CST 1	CC 3, GP 1, CST 1, MW 1
T04.07	*Cassiope tetragona* mountain heaths	NT	NT–EN	B1,2a(ii,iii)b	–	NT		GP 1–2	GP 1–2, CC 1
T04.08	Calcareous Dryas *octopetala* mountain heaths	NT	LC–EN	B1,2a(ii,iii)b	–	VU	3	GP 1–2, CC 1, GP & CC 1	GP 1–2, CC 1, GP & CC 1
T04.09	Non-calcareous Dryas *octopetala* mountain heaths	VU		B1,2bc, CD2a	–		4	CC 2, GP 1, GP & CC 1	CC 2, GP 1, GP & CC 1
T05	**Low-graminoid mountain heaths**								
T05.01	*Nardus stricta* mountain heaths	LC			=	LC			CC 1
T05.02	*Festuca ovina-Juncus trifidus* mountain heaths	LC			=	LC			CC 1
T06	**Mountain meadows**								
T06.01	Low-herb mountain meadows	LC			=	LC			CC 1
T06.02	Tall-herb mountain meadows	NT	NT–EN	B1,2a(ii,iii)b, CD1	=	NT		CC 2, GP 2, GP & CC 1–2	CC 2, GP 2, GP & CC 1–2
T06.03	*Salix*-rich brookside mountain meadows	LC			=	LC			
T06.04	Fern-rich mountain meadows	LC			=	NT	3		CC 1

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

Code	Habitat type	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
T07	**Snowbeds and snow patches**								
T07.01	Snowbeds	CR	EN–CR	A2a	–	NT	2, 3, 1	CC 3, GP 1	CC 3, GP 1
T07.01.01	Oligotrophic snowbeds								
T07.01.01.01	Oligotrophic *Salix herbacea* snowbeds	CR	EN–CR	A2a	–	LC	2, 3, 1	CC 3	CC 3
T07.01.01.02	Oligotrophic low-graminoid snowbeds	CR	EN–CR	A2a	–	LC	2, 3, 1	CC 3	CC 3
T07.01.01.03	Oligotrophic low-herb snowbeds	CR	EN–CR	A2a	–	NT	2, 3, 1	CC 3	CC 3
T07.01.01.04	Oligotrophic bryophyte-rich snowbeds	CR	EN–CR	A2a	–	NT	2, 3, 1	CC 3	CC 3
T07.01.01.05	Oligotrophic *Ranunculus glacialis* snowbeds	EN		B1,2a(i,ii,iii)b, C2b	–	NT	2, 3, 1	CC 3, GP 2	CC 3, GP 2
T07.01.02	Eutrophic snowbeds								
T07.01.02.01	Eutrophic heathlike snowbeds	EN		B1,2a(i,ii,iii)b, C2b	–	NT	2, 3, 1	CC 3	CC 3
T07.01.02.02	Eutrophic low-herb snowbeds	EN		B1,2a(i,ii,iii)b, C2b	–	NT	2, 3, 1	CC 3	CC 3
T07.01.02.03	Eutrophic bryophyte-rich snowbeds	CR		B1a(i,ii,iii)b	–	VU	2, 3, 1	CC 3	CC 3, GP 1
T07.02	Snow patches	CR		B1a(i,ii)b	–	EN	2, 3, 1	CC 3	CC 3
T08	**Patterned grounds and solifluction sheets**								
T08.01	Patterned grounds	NT	LC–NT	CD2a	–	LC	2, 3	CC 1	CC 1, GP 1
T08.02	Solifluction sheets	NT	LC–NT	CD2a	–	LC	2, 3	CC 1	CC 1, GP 1
T09	**Frost-influenced heaths**	VU		CD2a	–	LC	2, 3	CC 2	CC 2
T10	**Mountain dunes and deflation basins**	NT		A2a, B1,2b	–	LC	2, 5, 3	CC 1–2	CC 1–2, MW 1, GP 1
T11	**Mountain rock outcrops and boulder fields**								
T11.01	Mountain acidic and intermediate-basic flat rock outcrops	LC			=	LC			GP 1, MW 1
T11.02	Mountain acidic and intermediate-basic steeps	LC			=	LC			
T11.03	Mountain calcareous rock outcrops and boulder fields	LC			=	NT	3		MW 1, RTF 1
T11.04	Mountain serpentine rock outcrops and boulder fields	LC			=	NT	3		RTF 1
T11.05	Fe and Cu sulphide-rich rock outcrops and boulder fields	LC			=		4		EXT 1, CST 1, MW 1
T11.06	Mountain acidic and intermediate-basic boulder fields	LC			=	LC			
T11.07	Talus formations								
T11.07.01	Acidic and intermediate-basic talus formations	LC			=	LC			
T11.07.02	Calcareous talus formations	LC			=	NT	3		RTF 1
T12	**Fell habitat complexes**								
T12.01	Canyons	LC			=		4		
T12.02	Gorges and channels	LC			=		4		

Criterion-specific results and criteria decisive for the final IUCN Red List categories

All of the IUCN RLE criteria were used in the threat status assessments of fell habitat types, except for a quantitative risk analysis of the probability of collapse (criterion E) (Figure 4.60). All of the fell habitat types were assessed with regard to their quantitative development over three examination periods, that is, over the past 50 years (criterion A1), since 1750 (criterion A3) or in the future (criterion A2a or A2b). Also geographic distribution and related decline (criteria B1 & B2) were examined as regards all of the fell habitat types. The majority (> 90%) of the habitat types were also assessed with regard to any changes having taken place in their quality over the past 50 years (criterion C/D1) or over the historical time frame (criterion C/D3). There were slightly fewer cases where the habitat types' future qualitative development (criterion C/D2a or C/D2b) or the number of locations (criterion B3) was assessed (Figure 4.60).

Quantitative change over the historical time frame (A3) resulted in the classification of around half of the habitat types as Data Deficient (DD) and the other half as Least Concern (LC) (Figure 4.60). The DD category was chosen in cases where the habitat type could not due to the absence of suitable data be assessed as LC or only slightly altered in terms of quantity and it was not possible to conduct an assessment of quantitative change. When assessed on the basis of quantitative change over the past 50 years (A1), around 70% of fell habitat types were classified as Least Concern (LC) and slightly under 20% as Near Threatened (NT), while only

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

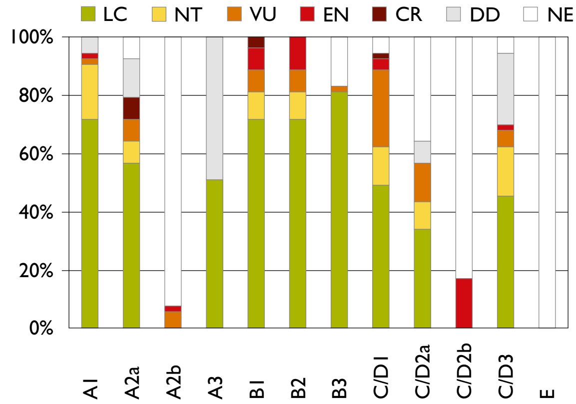


Figure 4.60. Fell habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of these criteria. The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. The figure only includes assessment units at the lowest hierarchical level of the classification (53 types).

2 habitat types were classified as threatened: *Empetrum-Lichenes* mountain birch forests (VU) and snow patches (EN).

The future quantitative development of habitat types (A2a & A2b) was assessed on the basis of forecasts of the dispersal of coniferous forests, reductions in the occurrence areas of species typical of snowbeds and decreases in the size of snow patches, but expert assessments of increasing damage caused by moth outbreaks and of intensity of grazing were also used. Just over half of the fell habitat types were assessed on the basis of future development as Least Concern (LC) and less than 10% as Near Threatened (NT), whereas all snowbed types, snow patches as well as dry and dryish mountain birch forest types were assessed as threatened (CR, EN or VU). The development of habitat types was evaluated mainly using criterion A2a, that is, over the next 50 years. For eutrophic snowbed types and snow patches the criterion used was A2b, which covers a period including the past, present and future (1990–2040), as there was data available on the extent of spots of snow preserved until the summer for that period of time (Niittynen 2017) (Figure 4.60).

When assessed on the basis of geographic distribution as well as their possible decline and threats faced by them (B1 & B2), around 70% of fell habitat types were classified as Least Concern (LC), around 10% as Near Threatened (NT) and the rest as threatened (CR, EN or VU) (Figure 4.60). Habitat types which are rare, declining and therefore assessed as threatened comprise the mesic mountain birch forest types, tall-herb mountain birch forests, eutrophic snowbed types, oligotrophic *Ranunculus glacialis* snowbeds, and snow patches (Table 4.9). There are also other small-sized and rare habitat types among fell habitat types, such as fern-rich mountain meadows or calcareous rock outcrops and boulder fields, but according to the expert assessments these are not declining nor face significant threats causing decline. Around 80% of the habitat types were assessed as Least Concern (LC) on the basis of criterion B3, and only 1 type – *Empetrum* mountain birch forests – was assessed as Vulnerable (VU) on the basis of it. The criterion was not applied to just under 20% of the fell habitat types, with all of these being snowbeds or snow patches.

The quality of habitat types was assessed as having remained more or less unchanged (LC) over the past 50 years (C/D1) for just under 50% and since 1750 (C/D3) for around 40% of the assessed fell habitat types. The percentage of habitat types classified as Data Deficient (DD) on the basis of qualitative development over the historical time frame is around 20% and as Near Threatened (NT) 10%. Only 2 dryish mountain birch habitat types were assessed as threatened (EN, VU) on the basis of a decline in quality over the historical time frame (Figure 4.60, Table 4.9). A decline in quality over the past 50 years (C/D1) resulted in the classification as threatened for around 30% of the fell habitat types (all snowbed types and snow patches, dry and dryish mountain birch forests as well as mesic mountain birch forests and tall-herb mountain birch forests). The quality of only a little over 30% of the habitat types is assessed as remaining more or less unchanged or as declining only slightly (LC) in the future. All snowbeds and snow patches were assessed on the basis of this criterion as Endangered (EN) and several mountain birch forest types and a few mountain heath types as Vulnerable (VU) (Figure 4.60, Table 4.9).

Appearing almost equally often as decisive criteria determining the overall threat status category of threatened and Near Threatened (NT) fell habitat types were habitat types' quantitative or qualitative future development (A2a, C/D2a or C/D2b), qualitative development over the past 50 years (C/D1) or their restricted geographic distribution and their decline (B1 & B2) (Figure 4.61). Quantitative change projected to take

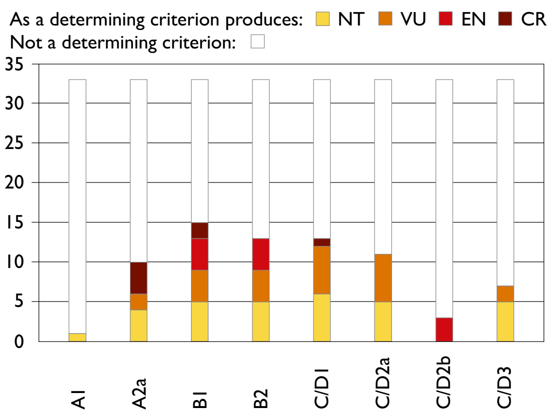


Figure 4.61. Decisive criteria determining the overall threat status for threatened and Near Threatened (NT) fell habitat types. The y-axis shows the total number of threatened and NT habitat types (33 habitat types) and the coloured sections of the bars indicate the number of habitat types for which the criterion in question alone or together with another criterion was the decisive criterion determining the overall threat status. The colours also represent the IUCN Red List categories assigned on the basis of the assessment.

place in the future warranted the final Red List category of 10 habitat types, mainly together with other criteria (Table 4.9). It was the sole reason for 4 oligotrophic snowbed types. Future qualitative development was one of the decisive criteria determining the final Red List category for 14 habitat types, most often together with B criteria. It was the sole decisive criterion only for patterned grounds and solifluction sheets (NT) as well as for frost-influenced heaths and *Calluna* mountain heaths (VU).

The B1 and/or B2 criteria were the decisive criteria in the assessment of snow patches (CR), eutrophic snowbeds (CR, EN), oligotrophic *Ranunculus glacialis* snowbeds (EN), mesic mountain birch forest types (EN, VU), tall-herb mountain birch forests (VU), non-calcareous *Dryas octopetala* mountain heaths (VU), *Cassiope tetragona* mountain heaths, calcareous *Dryas octopetala* mountain heaths, tall-herb mountain meadows and mountain dunes and deflation basins (NT). Quality decline over the historical time frame (C/D3) was the criterion deciding the final Red List category of 5 Near Threatened (NT) and 2 Vulnerable (VU) habitat types (Figure 4.61); all of these habitat types are dryish mountain birch forests. Quantitative change over the past 50 years (A1) was the decisive criterion determining the category of only 1 Near Threatened (NT) habitat type – mountain birch scrubs – and even there not alone but together with criterion A2a, which pertains to future quantity.

There were 4 snowbed types classified as Critically Endangered (CR) on the basis of a projection concerning the future (A2a, Figure 4.61). A reduction of at least 80% in their quantity is projected to take place over the next 50 years due to climate change and the resulting shortening of the period of snow cover and the reduction in the size of spots of snow. Eutrophic bryophyte-rich snowbeds, and snow patches were assessed as Critically Endangered (CR) due to their restricted geographic distribution and decline caused by climate change (B1) and *Empetrum-Lichenes* mountain birch forests due to the decline in their biotic quality (D1).

Classified as Endangered (EN) were *Empetrum* mountain birch forests and 3 snowbed types due to their restricted geographical distribution and their decline caused by climate change (B1 & B2), with snowbeds also additionally due to the decline in the quality of their abiotic environment (C2b) (Figure 4.61).

One of the criteria deciding the final Red List category for all of the fell habitat types classified as Vulnerable (VU) was a decline in overall quality having already taken place or projected to take place in the future (C/D1, C/D2 and/or C/D3) (Figure 4.61). *Empetrum-Lichenes-Pleurozium* mountain birch forests and *Empetrum-Myrtillus* mountain birch forests were assessed as VU also additionally due to their projected future quantity (A2a): their quantity is assessed as decreasing by at least 30% over the next 50 years due to climate change and grazing pressure. In addition, *Cornus-Empetrum-Myrtillus* mountain birch forests, *Cornus-Myrtillus* mountain birch forests, tall-herb mountain birch forests and non-calcareous *Dryas octopetala* mountain heaths were assessed as Vulnerable (VU) due to their restricted geographic distribution (B1 and B2) and their continuing decline.

Among the fell habitat types classified as Near Threatened (NT), the criteria deciding the final Red List category comprised quantitative change (A1 & A2a), restricted geographic distribution and continuing decline (B1 & B2) and/or qualitative change (C/D1, C/D2 and/or C/D3).

Figure 4.62. Damaged by the autumnal moth (*Epirrita autumnata*) in the 1960s and having subsequently been subjected to intensive grazing pressure, many mountain birch forests have been replaced by secondary mountain heaths. Photo: Arto Saikkonen

4.8.2
Reasons for becoming threatened and threat factors

Climate change and herbivory, particularly reindeer summer grazing, are the most significant factors affecting the state of fell habitat types. Global warming has been shown to cause the timberline of mountain birch and coniferous forests climbing to the fell area (e.g. Holtmeier et al. 2003; Juntunen and Neuvonen 2006; Sutinen et al. 2012) as well as to increase the growth of willows (*Salix* spp.), other shrubs and dwarf shrubs in open fell habitat types (e.g. Pajunen et al. 2008; Kitti et al. 2009; Olofsson et al. 2009; Ravolainen et al. 2014; Christie et al. 2015). As global warming advances, damage by insects – in the fell area the outbreaks of the autumnal and the winter moth (*Epirrita autumnata* and *Operophtera brumata*) – are projected to become more common (Virtanen et al. 1998; Neuvonen et al. 2005; Jepsen et al. 2008; Karlsen et al. 2013). Warming has also been found to increase bryophyte growth and impair the growth of lichens in some fell habitat types (Lang et al. 2012; Maliniemi et al. 2018).

The summer grazing of reindeer in turn has been observed to suppress regeneration of the mountain birch (*Betula pubescens* subsp. *czerepanovii*) from both basal sprouts and seeds and the growth of willows (*Salix* spp.) (Pajunen et al. 2008; Ravolainen et al. 2014; Christie et al. 2015) and it may prevent treeless habitats (especially mountain heaths) from becoming overgrown with trees or scrubs due to climate change. On the other hand, the timberline of mountain birch forests has in many places descended or birch (*Betula pubescens* ssp. *czerepanovii*) stands have been lost in areas where summer grazing has prevented the regeneration of trees and shrubs after damage caused by moth outbreaks. With moth outbreaks becoming more common due to the warming of autumns and winters, summer grazing may therefore also strengthen the negative impacts of climate change in fell habitats, especially in mountain birch forests.

When assessing the significance of the main reasons for fell habitat types becoming threatened and the threat factors faced by them (climate change (CC) and grazing pressure (GP)), efforts were made to itemise these factors' impacts separately as well as to take into account their combined effect (GP & CC) and its significance in relation

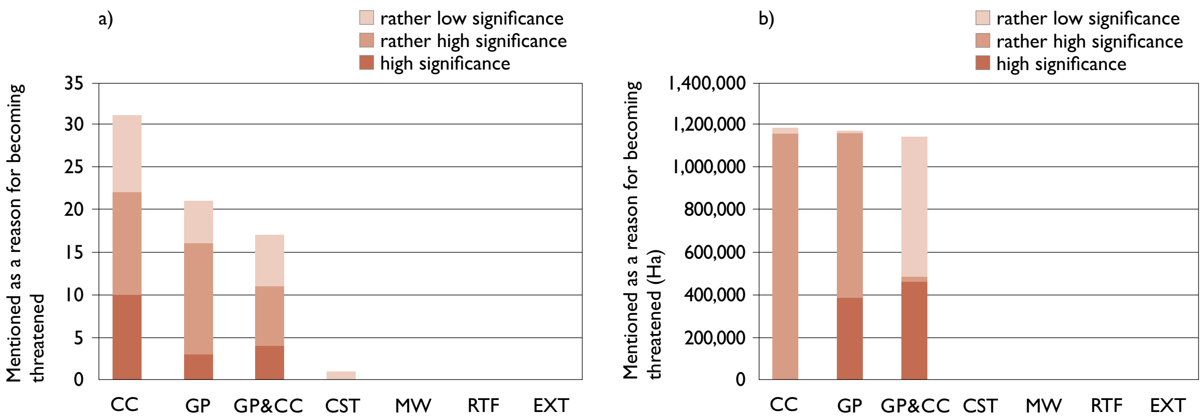


Figure 4.63. Reasons for becoming threatened of fell habitat types according to a) the number of habitat types and b) their area. The reasons for habitat types becoming threatened are given in the order of their overall significance. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. To facilitate comparisons, the threat factors in Figure 4.64 are given in the same order as the reasons in this figure.

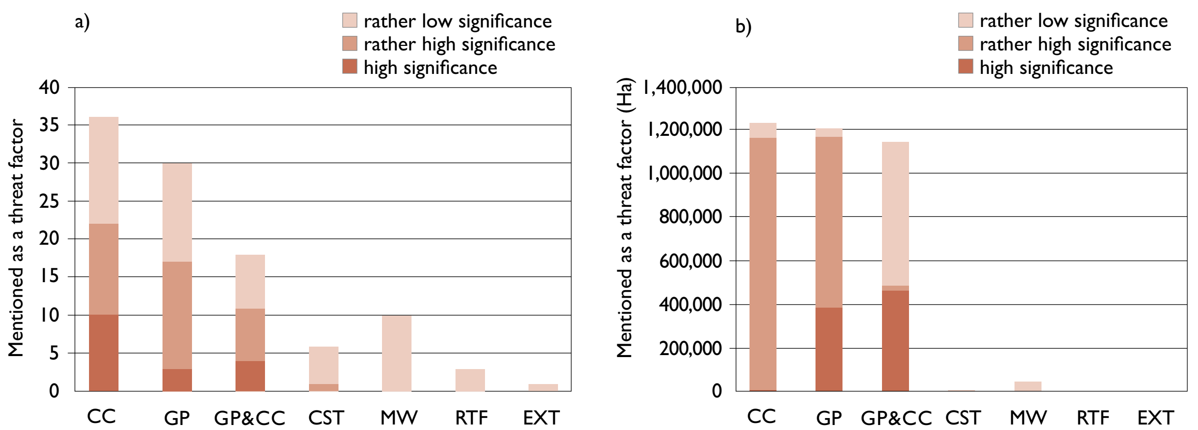


Figure 4.64. Threat factors of fell habitat types according to a) the number of habitat types and b) their area. The abbreviations of the threat factors are explained in section 2.6. To facilitate comparisons, the threat factors are given in the same order as the reasons for becoming threatened in Figure 4.63.

Fell habitats

to both individual factors. Mountain birch forests are a habitat type group which benefits from climate change thanks to the improved growing conditions but, on the other hand, increasing moth outbreak occurrences are causing recurring damage. With its effect combined with that of the summer grazing of reindeer, moth damage has caused the decline of birch forests and even deforestation across extensive areas (Olofsson et al. 2009). If a mountain birch forest does not regenerate after moth damage (Kukkonen 2002), it will be replaced by a secondary mountain heath (Sihvo 2002; Chapin et al. 2004; Figure 4.62). The threat posed by the combined effect is high especially in dry and dryish mountain birch forests as their capacity to recover from moth damage is poorer than that of mesic or herb-rich mountain birch forests. Mountain birch forests are therefore a good example of a situation where the impact of threats on a habitat type is intensified by their combined effect.

In mountain heaths, grazing mitigates the adverse effects of climate change as it prevents scrub encroachment and the spread of the mountain birch to this habitat type (Herder et al. 2008; Pajunen et al. 2008; Christie et al. 2015). Nevertheless, the combined effect does not prevent all of the negative impacts of the threat factors, such as the decline of fell species as the climate is warming or the mechanical degradation of mountain heaths under intensive grazing pressure. Reindeer grazing does not have the same preventive effect on conifers spreading to mountain heaths as it does on the spreading of the mountain birch. Instead, grazing may actually promote the establishment of coniferous trees.

The threat status of the 33 fell habitat types classified as threatened or Near Threatened has been affected the most by climate change (CC), and climate change is mentioned as the reason for 31 habitat types becoming threatened (Figure 4.63a). On the basis of area, climate change has an impact on almost the entire fell area and is relevant to 1.2 million hectares or 91% of the total area of fell habitat types (Figure 4.63b). Climate change is the only reason for the increased threat status of 12 habitat types that are dependent on snow cover or ground frost, which means almost all snowbeds and snow patches as well as patterned grounds and solifluction sheets (total area 44,000 ha). The significance of climate change as a reason for these habitat types becoming threatened is high (Table 4.9). Climate change was assessed as having had a rather high significance as regards dry mountain birch forests and many mountain heath types in particular becoming threatened and a low significance especially with regard to mesic and herb-rich mountain birch forest types. For mountain forests with aspen, pine or spruce and a few other habitat types classified as Least Concern (LC), climate change is not impairing their state but may, on the contrary, promote their expansion.

The second-most significant reason for fell habitat types becoming threatened is intensive reindeer grazing pressure (GP) (Figure 4.63a), which appears as a reason for 21 habitat types being classified as threatened or Near Threatened (NT) (Table 4.9). Like climate change, the impact of grazing pressure is also extensive: it is estimated to affect almost 1.2 million hectares or 90% of the total area of fell habitat types (Figure 4.63b). The significance of grazing pressure is high as a reason for 2 of the driest mountain birch forest types and for wind-exposed mountain heaths, rather high for 13 habitat types and low for 5 habitat types. In some habitat types assessed as Least Concern (LC), such as low-graminoid mountain heaths and low-herb mountain meadows, grazing pressure does not impair the state of these habitat types. Instead, they are in part maintained by grazing.

The third-most significant reason for fell habitat types becoming threatened is the combined effect of climate change and grazing pressure (CC & GP), which is mentioned as a reason for 17 habitat types being classified as threatened or Near Threatened (NT) (Figure 4.63a, Table 4.9). Its impact, too, is extensive and estimated to affect almost 1.1 million hectares or 88% of the total area of fell habitat types (Figure 4.63b). As mentioned above, the combined effect of climate change and grazing pressure may be either more or less significant than the respective separate effects of the factors. The effects of grazing and climate change on fell habitats are described extensively in sections 4.8.4 and 4.8.5.

Construction (CST), especially tourism-related, was assessed as one of the reasons for *Calluna* mountain heaths becoming threatened. Many of them are located on near ski resorts on isolated fells south of the continuous fell area (Table 4.9, Figure 4.63).

The threats faced by fell habitat types are mainly the same as the reasons for them becoming threatened, and their assessed significance also largely corresponds to the significance of the reasons. The biggest threats are climate change (CC), intensive grazing pressure (GP) and their combined effect (GP & CC) (Figure 4.64a, Table 4.9). The significance of climate change as a threat is high for 10 fell habitat types (snowbeds and snow patches, and *Calluna* mountain heaths). Rising temperatures, increasing precipitation rates and earlier melting of snow have an adverse effect on these habitat types. Snowbed and snow patch species have adapted to low temperatures and short growing seasons. They decline rapidly if the snow-covered period becomes shorter, the soil dries in the summer and competitive species spread to their growing sites from surrounding habitat types (Björk and Molau 2007). As the climate warms, the plant communities of these habitat types eventually turn into mountain heaths and meadows. In contrast, for *Calluna* mountain heaths of isolated southern fells in particular, the climbing of the conifer timberline is a climate change-related threat.

The significance of the threat posed by climate change was assessed as rather high for 12 fell habitat types (Figure 4.64a). These comprise dry and dryish mountain birch forests, several mountain heath types, and frost-influenced heaths. Climate chance may have both a positive and a negative effect on mountain birch forests, which is why its significance as a threat was assessed only as rather high. A positive effect may be created when global warming increases the growth of birch stands and results in the birch timberline climbing higher up fells. A negative effect is caused by the increasing rate of moth damage and the projected ascent of the conifer timberline. Climate change is regarded as a threat factor for almost all fell area habitat types, and its significance is high when examined on the basis of the area covered by the habitat types (Figure 4.64b).

On the basis of the number of habitat types, the second-most significant threat factor for fell habitat types is grazing pressure (GP), which is at least one of the threats faced by 30 fell habitat types (Figure 4.64a). The significance of grazing pressure is high for the driest mountain birch forest types and for wind-exposed mountain heaths (i.e. a total of 3 habitat types) and rather high for the majority of mountain birch forests, mountain heaths and mountain heath scrubs (14 habitat types, Table 4.9). When examined on the basis of area, the significance of grazing pressure as a threat is considerable: it affects around 1.2 million hectares or 90% of the total area of fell habitat types, with its significance being high for a third and rather high for almost two thirds of the total (Figure 4.64b). Climate change, grazing pressure as well as their combined effect are assessed as being the most significant threats to an increasing number of fell habitat types in the future.

In addition to climate change, grazing pressure and their combined effect, other factors assessed as posing a threat to fell habitat types comprise construction (CST), mechanical wear (MW), random factors (RTF) and extractive activities (EXT) (Figure 4.64). The significance of construction as a threat was assessed as rather high for *Empetrum* mountain birch forests and as low for some dry mountain birch forest types and for *Calluna* mountain heaths. Mechanical wear, random factors and extractive activities were assessed as being of low significance and affecting small-sized mountain rock outcrop and boulder field types in particular but also some mountain birch forest and mountain heath types.

4.8.3
Comparison with previous assessment

The threat status of the fell habitat types was assessed using the IUCN methodology (IUCN 2015). The previous assessment completed in 2008 employed a national method (Raunio et al. 2008) which, among other things, provided the option of downlisting on the basis of a habitat type being common and widespread or uplisting on the basis of a habitat type being rare and small in size. The IUCN methodology does not provide this option.

The results of the threat status assessment of fell habitat types differ clearly between the current and the previous assessment (Norokorpi et al. 2008) in that, with the exception of one case (calcareous *Dryas octopetala* mountain heaths), all of the threatened habitat types were now uplisted from the 2008 assessment (Figure 4.65). The most important reason for this is a change in method, which is why the assessment results are not directly comparable with the results of the 2008 assessment. A change in method was one of the reasons for a change of Red List category for all of the results that differ from the previous assessments, and for mountain birch forests and calcareous *Dryas octopetala* mountain heaths this is the primary reason. It is, however, significant that also a genuine change or an increase in knowledge is a contributory reason for the change of category for more than 20 habitat types. A genuine change in the state of habitat types was assessed as the second-most important reason for a change of Red List category for mountain birch forests, with increasing damage caused by geometrid moths as well as grazing pressure affecting both the quantity and the quality of these habitat types. For snowbeds and snow patches, increased knowledge was assessed as the most important reason for the change of Red List category which, coupled with the change in assessment methodology and a genuine change resulted in these habitat types being uplisted by one or more categories. The RCP4.5 scenario was used as the climate change trajectory, and the projected pathway could be utilised when producing assessments concerning, for example, snowbed species. In addition, the dispersal of coniferous forests could be assessed as July mean temperatures rise. Data like this was not available for the 2008 assessment. Habitat types placed in the Not Evaluated (NE) category in Figure 4.65 are new ones that were only introduced in the 2018 classification of fell habitat types. These comprise mountain forests with aspen, pine or spruce (3 habitat types), non-calcareous *Dryas octopetala* mountain heaths, Fe and Cu sulphide-rich rock outcrops and scree as well as 2 fell habitat complexes (canyons, and gorges and channels).

IUCN method 2018 \ National method 2008	LC	NT	VU	EN	CR	DD	NE
LC	9	5					6
NT	3	9	1				
VU	1	5	2				1
EN		3	1				
CR	2	3	2				
DD							

Figure 4.65. Red List categories of fell habitat types using IUCN methodology in 2018 and their classification based on the national method in 2008. The highlighted figures show the number of classifications that remained the same for each category and the other figures indicate assessments that resulted in reclassifications. Figures in the NE column refer to new habitat types that were separated only in the second assessment in 2018.

According to the results of the threat status assessments of habitat types, the state of fell habitats has declined and is projected to decline further in the future, especially due to climate change. Fell habitat types classified as Least Concern (LC) only cover 6% of the total area of fell habitat types. Climate change has been a threat especially for habitat types dependent on snow and ground frost, such as snowbeds and snow patches as well as frost-influenced heaths. Climate change causes the ascent of the birch and conifer timberline and increased moth damage, boosts scrub, dwarf shrub and bryophyte dominance, shortens the period of snow cover, dries the top soil layer and reduces ground frost rates. This means climate change affects the state of almost all fell habitat types.

Another factor with large-scale impacts on fell habitats is intensive round-the-year grazing pressure which impairs the state of oligotrophic, lichen-rich fell habitat types in particular. Through consumption and trampling, intensive summer grazing impairs the growth and regeneration of the mountain birch and the state of lichen-rich areas, alters species compositions and causes erosion. Grazing pressure intensifies the effects of climate change on mountain birch forests and mitigates those on mountain heaths.

4.8.4 Reindeer grazing and pasture condition in the fell area

Jouko Kumpula and Minna Turunen

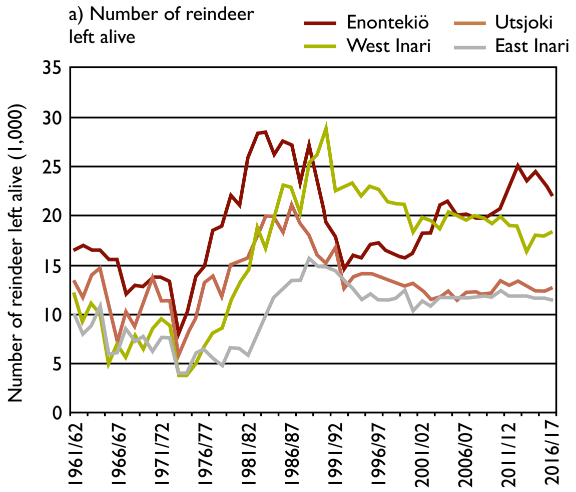
Development of reindeer husbandry

The wild mountain reindeer (*Rangifer tarandus*) and its semi-domesticated form (*Rangifer tarandus tarandus*) have belonged to northern fell and forest habitats as important herbivore mammals since the start of the post-glacial period. Wild reindeer usually undertake long seasonal migrations, which means their use of summer and winter grazing areas varies by season. The population size of wild reindeer is primarily controlled by predators, parasites, snow and weather conditions, deaths and stress caused by migratory journeys and, occasionally, by hunting or the deterioration of grazing areas due to intensive grazing (e.g. Messier et al. 1988; Valkenburg et al. 1994; Ferguson et al. 1998). The population densities of mountain reindeer have usually been below 1.5 individuals per km^2 of land (winter population) (e.g. Reimers et al. 2005).

Reindeer husbandry developed from the capturing of wild reindeer and became established in Finland by the mid-1750s in roughly the same area as the current reindeer husbandry area (Kortesalmi 1996; Kemppainen et al. 1997). In the fell area of Northern Lapland, reindeer herding used to be nomadic: herds would migrate across national borders to the coast and islands of the Arctic Ocean for the summer and return inland for the winter. Reindeer numbers in the fell area were fairly high from as early as the 1700s, and reindeer husbandry had developed into an intensive, mobile livelihood of the Saami. When Finland's northern and western borders were closed in the late 1800s and seasonal migrations consequently prevented (Nieminen and Pietilä 1999), Saami reindeer herders who remained within Finnish territory had to make their reindeer husbandry more sedentary and operate in a more confined area. When the summer migrations to the Arctic Ocean coast and islands ceased, reindeer had to be grazed year-round increasingly in areas overlapping winter pastures. The close herding of reindeer especially in the winter continued in fell areas until the early 1970s. After that the motorisation of reindeer herding following the introduction of snowmobiles reduced the need for continuous close herding. The most significant change in fell areas affecting lichen pastures was, however, the fact that hardly any reindeer herding took place in the summer any more, so reindeer were able to graze relatively freely in the summer months in areas overlapping winter pastures.

Unlike in the fell area, reindeer husbandry in the coniferous forest area has usually been more sedentary and reindeer numbers have been relatively low, especially in the early days of reindeer husbandry. Reindeer would wander or be moved to pasture areas suitable for each season. In the winter, reindeer would be herded in heath forests with terrestrial lichens but they would often be already allowed to graze freely in forests with arboreal lichens in the first months of the year. In the summer, reindeer would be free to graze on mires, by rivers and in the more eutrophic mineral soil areas. However, in areas such as Kuusamo, reindeer were moved in the winter to fairly distant lichen grounds on the Russian side of the border where they were herded until the early months of the year and then brought back to the Finnish side in the spring (Kortesalmi 1996). Once the Finnish-Russian border was closed, this conventional pasture rotation ended in Kuusamo as well. The gradual reduction in and fragmentation of terrestrial and arboreal lichen pastures in mature and old-growth forests, which took place because of expanding forestry and other land use, also reduced the natural alternation of reindeer between pasture areas typical of the season. The consequence of the weakening or ending of the traditional pasture rotation with alternation of pasture areas was that reindeer consumed lichen-rich winter pastures increasingly during the summer months, too.

In recent decades, reindeer husbandry has become more efficient and changed in many ways. Intensive herding in the winter has still continued in northern reindeer herding cooperatives in particular, but today's herding also involves providing supplementary feed for reindeer grazing on pastures. This helps to keep reindeer together and under control in suitable pasture areas. There have also been other changes, with practices such as calf slaughtering and antiparasitic medical treatment adopted in reindeer husbandry in recent decades. All of these changes have improved the viability and calf production of reindeer stock and increased and stabilised reindeer stock productivity. At the same time, however, they have suppressed the functioning of many natural population regulation



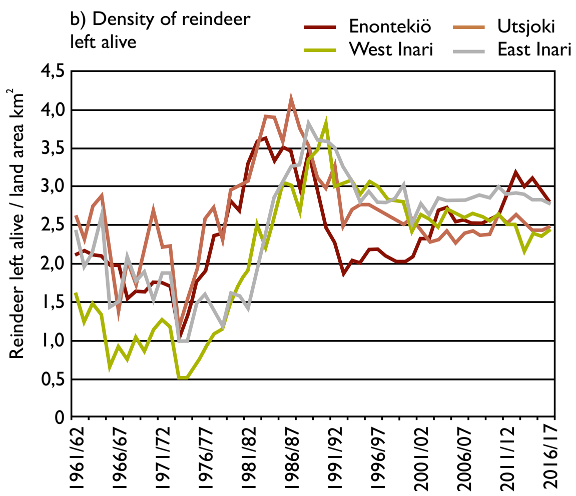


Figure 4.66. Trends in a) number of reindeer left alive and b) density of reindeer left alive (reindeer per km^2 of land) according to reindeer count statistics in reindeer herding cooperative areas of Northern Lapland for reindeer herding years 1961/1962–2016/2017). Areas and reindeer herding cooperatives: Enontekiö = Näkkälä and Käsivarsi; Utsjoki = Paistunturi and Kaldoaivi; West Inari = Muotkatunturi, Sallivaara and Hammastunturi, East Inari = Näätämö, Vätsäri and Muddusjärvi. Data source: Reindeer Herders' Association.

mechanisms that used to periodically affect reindeer numbers and productivity. The new reindeer husbandry methods have enabled reindeer numbers and reindeer stock productivity to be permanently kept relatively stable, which has also meant greater stability in incomes from reindeer husbandry (Kumpula 2001a; Pekkarinen et al. 2015). Previously, predators probably also had a clearer impact on reindeer stock regulation than they have today, although predators still cause significant losses in reindeer herds especially in northern and eastern cooperatives in Finland (Kumpula et al. 2017; Turunen et al. 2017a). Summertime reindeer densities have also increased since around 80% of the reindeer left alive are female. This means the number of calves is relatively high from the spring to the autumn slaughter season, and the summertime gross stock size (adults + calves) is therefore around one-and-a-half times larger compared with the wintertime stock size.

Trends in reindeer numbers can be examined on the basis of the reindeer count statistics of the Reindeer Herders' Association, which are available for each reindeer herding year since the beginning of the 1960s. However, these statistics involve uncertainties regarding the earlier decades since the accuracy of counting reindeer was lower than it is today. Previously, it was also common not to include all calves in the statistics. Nevertheless, these reindeer count statistics can be used as a basis for outlining trends in the number of reindeer over the various decades quite reliably. In the cooperatives of Northern Lapland, the increase in reindeer numbers was considerable between the late 1970s and the early 1990s (Figure 4.66a). However, in the early 1990s the numbers of reindeer fell to their current level in Utsjoki and East Inari whereas in the Enontekiö area the initial drop in the early 1990s was followed by a gradual increase to the current level. In contrast with this trend, the reindeer number in the West Inari area did not drop particularly steeply in the early 1990s but, instead, it decreased gradually to the current level. In the late 1980s, the maximum permitted reindeer count was exceeded in several reindeer herding cooperatives, and compulsory slaughtering took place to bring the numbers within the permitted level. Reductions in the maximum permitted number of reindeer in the 1990s and again in 2000/2001 have also affected reindeer numbers. After these reductions there have not been any further reductions in the maximum permitted reindeer numbers. During the past decade, reindeer herding cooperatives have been quite successful in keeping the counts of reindeer below the maximum permitted numbers, although in some cooperatives (particularly in the Enontekiö area) the counted reindeer numbers have still exceeded the permitted numbers in several consecutive years. Calculated on the basis of reindeer count statistics, the reindeer densities of herding cooperatives in Northern Lapland are currently fairly close to each other and fall within the range of 2.5–2.8 reindeer per km^2 of land (Figure 4.66b).

Reindeer food consumption

The summer diet consumed by reindeer may consist of hundreds of plant species. Their main diet, however, comprises a few dozen species, the most important of which are numerous herbaceous and graminoid plants as well as birch (*Betula* spp.) and willow (*Salix* spp.) leaves. Important plants that reindeer feed on in the summer include the bilberry (*Vaccinium myrtillus*), bog bilberry (*V. uliginosum*), wavy hair-grass (*Avenella flexuosa*), alpine meadow-grass (*Poa alpina*), sheep's fescue (*Festuca ovina*), rosebay willowherb (*Epilobium angustifolium*), hawkweeds (*Hierachium* spp.), cow wheats (*Melampyrum* spp.), hairy wood-rush (*Luzula pilosa*), wood cranesbill (*Geranium sylvaticum*), meadowsweet (*Filipendula ulmaria*), docks and sorrels (*Rumex* spp.) and lady's mantles (*Alchemilla* spp.). Also many mire and wetland species such as sedges (*Carex* spp.), marsh cinquefoil (*Comarum palustre*), bogbean (*Menyanthes* *trifoliata*), water horsetail (*Equisetum fluviatile*), sheathed cottongrass (*Eriophorum vaginatum*) and tufted bulrush (*Trichophorum cespitosum*) are essential components of the summer diet. Reindeer are also particularly fond of the garden angelica (*Angelica archangelica*) and rowan (*Sorbus aucuparia*) (Warenberg et al. 1997; Nieminen et al. 1998; see also Pajunen et al. 2008; Kitti et al. 2009). In the summer, reindeer graze in mires, herb-, graminoid- or sedge-dominated habitat types, in the fell area mainly in mesic and herb-rich mountain birch forests, low-graminoid mountain heaths and mountain meadows as well as in brookside *Salix* spp. thickets. Insect harassment and heat occasionally drive reindeer into seeking open and windy sites such as felltop areas and wind-exposed slopes as well as snowbeds. Through their grazing and trampling, reindeer have an impact on vegetation and soil (Virtanen 2000; Olofsson and Oksanen 2002; Herder et al. 2008; Pajunen et al. 2008; Kitti et al. 2009). Reindeer summer grazing and trampling in the fell area may have a strong impact on lichen grounds in dry and dryish mountain birch forests and in oligotrophic mountain heaths (Herder et al. 2003, Kumpula et al. 2004; 2011; Bernes et al. 2015).

In late summer, reindeer herds spread out to graze variably in different habitat types from mires all the way to felltops, consuming a diverse range of green plants and especially mushrooms such as boletes (*Boletus* spp., *Leccinum* spp., *Suillus* spp.), brittlegills (*Russula* spp.) and milkcaps (*Lactarius* spp.) (Warenberg et al. 1997, Kumpula et al. 2015). In late autumn and early winter, reindeer diet consists of an increasing rate of terrestrial lichens (mainly *Cladonia* spp.) and dwarf shrubs, such as the crowberry (*Empetrum nigrum*), bilberry, heather (*Calluna vulgaris*) and lingonberry (*Vaccinium vitis-idaea*), although herbs and sedges continue to account for a significant part of their diet (Kojola et al. 1995).

As reindeer are adapted to utilising terrestrial and arboreal lichens and as these have an essential effect on their capacity to survive the winter (Kojola et al. 1995; 1998; Kumpula et al. 1998; Bernes et al. 2015), reindeer winter grazing focuses especially on all those habitat types where lichens are naturally abundant (Väre et al. 1995; 1996; Herder et al. 2003; Bernes et al. 2015, Kumpula et al. 2015). In the fell area, the impact of reindeer winter grazing may be strong on snow-free or almost snow-free wind-exposed mountain heaths. Conversely, in the most mesic habitat types the effect of reindeer grazing in the winter on vegetation is low. In the first months of the year when reindeer often have to dig for food under a thick snow cover, their diet consists of terrestrial lichens, dwarf shrubs, graminoids and sedges. Bryophytes are also included in their diet even though reindeer probably do not actively select them (Kojola et al. 1995; Ophof et al. 2013; Bernes et al. 2015). Reindeer also look for lichens growing on tree branches and trunks or eat arboreal lichens that have fallen on the snow. In Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) forest areas, bushy arboreal lichens (*Alectoria* spp., *Bryoria* spp.) and beard lichens (*Usnea* spp.) are particularly important food sources for reindeer in the first months of the year, but in the fell area these lichens are less available to reindeer. In the fell area, however, reindeer feed in the late winter on lichens growing on birch trunks and branches as well as on tube lichens (*Hypogymnia* spp.) and shield lichens (*Parmelia* spp.).

In the spring, reindeer grazing focuses on areas where the first snow-free patches appear and which provide early access to green vegetation. Hummock surfaces and mire edges are the first to lose their snow cover and reindeer go there to find rhizomes and young sprouts of mire plants such as the sheathed cottongrass, bogbean and marsh cinquefoil (Warenberg et al. 1997, Kumpula et al. 1999). In the fell area, dwarf shrub and low-graminoid mountain heaths losing their snow cover attract reindeer to feed in the first snow-free patches. Dry and dryish mountain birch forests are also habitats where reindeer look for lichen in the spring once the snow has melted (Kumpula et al. 2015). Availability of food plants and snow conditions generally regulates the proportion of each plant species in reindeer diet. For example, in fell areas where lichen grounds have deteriorated markedly for a long time (Kumpula et al. 1997; 2009), reindeer prefer mountain heaths with thin snow cover, mainly feeding on dwarf shrubs and graminoids (Kojola et al. 1995).

Impacts of grazing on fell area habitat types

Changes caused by reindeer grazing in Finland's fell area can be assessed over the past 50-year period on the basis of a variety of data and studies. Prior to that, reindeer husbandry was almost solely based on natural pastures, which caused significant variation in the number of reindeer and in grazing pressure over the longer time frame. Therefore also the impacts of reindeer grazing on vegetation were more periodic and localised compared with the current situation (Kumpula 2001a). Due to the changes in reindeer husbandry methods, variation in grazing pressure has, however, decreased significantly and therefore also changes caused by reindeer in pasture vegetation have been more permanent than earlier. Reindeer grazing shapes and alters the composition, structure and abundance of vegetation. Grazing also affects features such as the thickness of the humus layer. By altering vegetation and humus and trampling and fertilising the soil, reindeer also affect soil processes (Stark 2002; Olofsson et al. 2004; Wal et al. 2004). Reindeer grazing usually accelerates the rate of litter decomposition and nutrient cycling in the soil, which favours the growth of herbaceous and graminaceous plants as well as some dwarf shrubs, especially on more mesic sites. On the other hand, on more oligotrophic sites, intensive grazing reduces the growth of lichens in particular but also that of slow-growing woody plants (such as the dwarf birch, *Betula nana*). Changes in vegetation as well as in chemical processes and microbial activity in the soil may in turn affect the abundance and species composition of invertebrates living in the soil and on the ground (Suominen 1999; Suominen et al. 2003) as well as of insects living in vegetation (Olofsson and Strengbom 2000; Herder et al. 2004). There is very little research into the impacts of reindeer grazing on small mammals and birds but, according to a study conducted in Northern Norway, intensive grazing would appear to have a negative effect on the abundance of ptarmigans (*Lagopus* spp.) but a positive one on rodent populations (Ims et al. 2007).

The impacts of long-term reindeer grazing on vegetation have been studied quite a lot in recent years. Reindeer winter grazing results in clearest reductions in the quantity of terrestrial lichens and of arboreal lichens growing within the reach of reindeer on trees below the height of 2 metres (e.g. Väre et al. 1995; 1996; Herder et al. 2003). Intensive winter grazing may also reduce the quantity of relatively slow-growing dwarf shrubs, such as the heather, lingonberry, crowberry, creeping azalea (*Loiseleuria procumbens*) and mountain heath (*Phyllodoce caerulea*), although its impacts are often difficult to distinguish from the impact of summertime grazing. In the winter, the snow cover protects vegetation from trampling, and grazing is targeted in patches only on that part of vegetation where reindeer dig their craters (Kumpula 2001b). Therefore the impact of winter grazing on vegetation is not as intensive or evenly wearing as grazing during the summer (Löffler 2000; Kumpula et al. 2004; 2011), although certain fell habitat types that have a thin snow cover or are almost snowless may be subjected to intensive grazing in the winter, too.

Summer grazing affects the abundance of plant species and changes species abundance ratios in the various vegetation layers. Summer grazing and related trampling reduce the quantity of terrestrial lichens, bryophytes and some dwarf shrubs more clearly than winter grazing. Herbaceous species either decrease or become more abundant depending on their growing form and site. Some studies have shown a decrease in the bilberry as a result of reindeer grazing in the summer (Bråthen and Oksanen 2001; Olofsson et al. 2005) but, on the other hand, in dryish mountain birch forests the bilberry has also been observed to be more abundant in intensively grazed summer pasture areas than in winter pasture areas (Kumpula et al. 2011). Trampling may result in previously lichen-rich types becoming more bryophyte-dominated (Oksanen and Virtanen 1995; Väre et al. 1996).

Continuous and intensive grazing on mountain birches and willows affects the structure and abundance of mountain birch forests and *Salix* scrubs (e.g. Pajunen et al. 2008; Kitti et al. 2009; Kumpula et al. 2011). When reindeer repeatedly eat basal sprouts and seedlings, this may suppress the regeneration of mountain birches (Lehtonen and Heikkinen 1995; Helle et al. 1998; Herder and Niemelä 2003; Herder et al. 2004). In the long run, intensive summer grazing may gradually turn a mountain birch forest damaged by moth outbreaks into a new treeless habitat, a so-called secondary mountain heath. The impacts of summer grazing and related trampling can be seen most clearly in separate summer pasture areas and, in them, especially in the vicinity of pasture rotation fences (Evans 1996; Löffler 2000; Olofsson et al. 2001; Kumpula et al. 2011).

On the other hand, intensive summer grazing increases the biomass of graminoids (Löffler 2000; Virtanen 2000; Olofsson et al. 2001; 2005; Kumpula et al. 2011). Moderate summer trampling may also favour bryophytes and crustose lichens that benefit from open growing space, especially in calcareous rock areas. According to Linkowski and Lennartsson (2006), grazing favours those vascular plant, bryophyte and lichen species that are weak competitors. Moderate grazing pressure has been observed to increase species diversity in eutrophic and fairly eutrophic fell habitat types by promoting seed germination and seedling emergence in herbaceous and graminoid plants (Virtanen 2000; Olofsson and Oksanen 2002; Eskelinen and Virtanen 2005; Eskelinen and Oksanen 2006) and by helping small and light-demanding fell plants in competition with larger, shading plants (Eskelinen et al. 2016a; Kaarlejärvi et al. 2017). Reindeer also prevent scrub encroachment and the spread of the mountain birch to mountain heaths by eating birch and willow leaves and consequently keeping mountain heaths open and suitable as sites for many characteristic and also rare fell plants to grow. This means that the effects of reindeer grazing may be either positive or negative for the state of habitat types (Kauhanen and Mattsson 2005; Eskelinen and Oksanen 2006; Eskelinen 2008; Kaarlejärvi et al. 2017). Although reindeer may graze intensively on eutrophic habitat types in the summer and significantly reduce vegetation during the growing season, vegetation appears to also recover effectively after grazing (Bråthen and Oksanen 2001; Olofsson et al. 2002).

Lichen pastures have traditionally been the most important winter pastures for reindeer. Among the habitat type groups included in the threat status assessment, lichen pastures can be regarded as comprising dry and dryish mountain birch forests as well as oligotrophic mountain heaths. Long-term intensive grazing not only affects the proportions of the various lichen species but also the coverage, length and biomass of the most important lichens (Väre et al. 1995; 1996; Kumpula et al. 2000). In wooded lichen heaths with Scots pines or mountain birches, the dominant species are reindeer lichens (*Cladonia* spp.), especially the *C. stellaris*, *C. mitis*, *C. arbuscula*, *C. rangiferina* as well as the *C. uncialis* subsp. *uncialis* (Ahti 1957). These are also the key species with regard to the diet of the reindeer, although in fell areas the crinkled snow lichen (*Flavocetraria nivalis*) and foam lichens (*Stereocaulon* spp.) may be common.

The condition of lichen pastures can be evaluated on the basis of a classification of their ecological state. The classification is based on observations and findings compiled by, for example, Ahti (1957; 1978) and Kumpula et al. (2000; 2006). The classification and related values presented in this report (Table 4.10) have been updated since the classification provided in the previous assessment of the threat status of habitat types (Norokorpi et al. 2008). The update is based on the latest measurement data obtained from long-term monitoring of sample plots in permanent lichen pastures of Natural Resources Institute Finland (Kumpula et al. unpublished; see Tahvonen et al. 2014; Pekkarinen et al. 2015). The classification consists of the four most

Table 4.10. Classification indicating the ecological state of reindeer lichen grounds. Observations and findings by Ahti (1957; 1978) and Kumpula et al. (2000; 2006) concerning the condition and regeneration of lichen grounds were utilised in the evaluation of the ecological state of lichen grounds. The coverage, length, biomass and annual production of lichens for the lichen ground categories have been updated from those used earlier (Norokorpi et al. 2008) by using the most recent findings based on long-term monitoring data by Natural Resources Institute Finland from sample plots of lichen grounds in dry and semi-dry heaths (Kumpula et al. unpublished; see Tahvonen et al. 2014; Pekkarinen et al. 2015).

Ecological state of reindeer lichen grounds	Reindeer lichen (living part)			
	coverage (%)	length (mm)	biomass (kg/ha)	production (kg/ha/year)
Intensively worn out	< 15	< 15	< 100	< 25
Slowly regenerating	15–30	15–25	100–500	25–80
Well-regenerating	30–45	25–40	500–1,500	80–130
Maximum-stage productivity	45–60	40–55	1,500–3,500	130–150
No grazing	60–70	55–70	3,500–6,000	150–130
Climax stage	> 70	> 70	> 6,000	< 25

common lichen species: reindeer lichens *C. stellaris*, *C. mitis* (and *C. arbuscula*), *C. rangiferina* and thorn cladonia *C. uncialis* subsp. *uncialis*. Lichen length and biomass are given in each category only for the living part of the lichen. The limit values provided are not, however, absolute as lichen grounds occur on different site types, in all of which the coverage of lichen also varies naturally in the ungrazed state. The previous classification (Norokorpi et al. 2008) was best-suited for those oligotrophic site types that are the most optimal for lichen growth and richest in lichen, namely relatively open oligotrophic heath forests with old Scots pines. The updated classification provides more comprehensive variation of lichen grounds on dry sites.

Changes in the state of lichen grounds

The condition of lichen pastures has been assessed to have gradually declined throughout the 1900s (Helle 1980), but especially since the 1970s the deterioration of lichen grounds has been rapid (Kärenlampi 1973; Kautto et al. 1986; Mattila 1988; 1996). According to a memorandum of the reindeer pasture commission (Porolaidunkomisioonin mietintö 1914), the condition of lichen grounds was good throughout the Ylä-Lappi subregion of Lapland in 1900. In those days, lichen grounds were regarded as being in good condition when their lichen length was at least 5 cm. This means in accordance with the above-mentioned ecological classification they would be classified as lichen grounds with maximum-stage productivity (Table 4.10). By 1962, the condition of lichen grounds in Ylä-Lappi had deteriorated to moderate according to an evaluation compiled by Helle (1980). That condition category is likely to correspond to the well-regenerating category of the above-mentioned classification. Since then, the condition of lichen grounds has clearly deteriorated further and in the mid-2000s lichen grounds in moderate (well-regenerating) condition could only be found in the winter pasture areas of a few reindeer herding cooperatives (Kumpula et al. 2009). In the fell area, lichen grounds are almost always classified as intensively worn out or slowly regenerating (Kumpula et al. 2009). The decline in the state of lichen grounds that has taken place in Northern Lapland is, however, clearest in reindeer herding cooperatives of forest areas, although in them lichen biomass is still clearly higher than in the fell area.

The long-term reindeer densities of lichen pastures and the pasture rotation systems of reindeer herding cooperatives explain the differences in the condition of lichen grounds between cooperatives and their pasture areas quite well (Helle et al. 1990; Kojola et al. 1993, Kumpula et al. 2000; Kumpula 2001a; Kumpula et al. 2006; 2014). In the fell area, reindeer grazing is the most significant factor affecting the condition of lichen grounds but, in areas of more intensive land use, the condition of lichen grounds is also affected strongly by forestry and the extent of other land use activities. Regional weather and climate factors, especially summer precipitation and temperatures, have been observed to affect lichen quantities. The effects and intensity of the various factors on the current state of lichen grounds is, however, often difficult to assess in different reindeer herding cooperatives, as quantities of lichen are in most cases affected simultaneously and interconnectedly by factors dependent on reindeer husbandry, forestry and other land use as well as climate change alike (Kumpula et al. 2014).

4.8.5 Finland's fell habitats and climate change

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Climate change is one of the most significant factors posing a threat to biodiversity and may lead to the decline or, at worst, the loss of several species (Thomas et al. 2004; Bellard et al. 2012; Segan et al. 2016). The rate of warming is highest in the northern regions, including the fell areas of Fennoscandia (Larsen et al. 2014; Ruosteenoja et al. 2016a; 2016b). Consequently, the

Figure 4.67. The Scots pine (*Pinus sylvestris*) is spreading to the fell area. Látnjoaivi, Lemmenjoki National Park, Inari. Photo: Arto Saikkonen

characteristic species and habitat types of the Arctic region and the oroarctic and hemioroarctic fell areas are heavily exposed to the impacts of climate change. The spread of new competitive species may adversely affect the success of current species established in the area and pose a threat to diversity (ACIA 2005; Thuiller et al. 2008; Elmendorf et al. 2012; CAFF 2013; Bjorkman et al. 2018). The threats are intensified by the fact that the Arctic Ocean forms an impassable dispersal barrier to many northern species, preventing them from moving further north as the climate warms.

There can be a great deal of variation in fell plant tolerance of global warming (Moen et al. 2004; Mikkola and Virtanen 2006). The most threatened plant species are ones adapted to cold conditions which have a narrow temperature tolerance and a small range. In addition, these species are often character species of nutrient-rich sites and of snowbeds. Most of the species studied, however, have a broad tolerance to temperature variation. This means that an increase of 2 °C in summer or 4 °C in winter temperatures does not necessarily have a direct adverse effect on all fell plant species. In the future, decline of fell species may be significantly related to changes in vegetation structure and in interspecific competitive relationships.

Conifer timberline climbing higher

In addition to summer temperatures, the conifer timberline migration rate and fell habitat types are affected by winter temperatures, precipitation rates, snow cover distribution, wind conditions, topography, soil conditions and herbivory. As the climate warms, the timberline will climb higher in areas where soil-related factors, extreme weather conditions or competition between conifer seedlings, dwarf shrubs and mosses for light and nutrients are not limiting factors (Autio and Colpaert 2005). Global warming increases forest tree seedling density and growth at the timberline, but changing climate may also increase effects that are detrimental to tree growth, such as storm and snow damage (Gregow 2011; Lehtonen et al. 2014), major temperature variations (Heikkinen et al. 2002) and conditions that are favourable to the occurrence of insect damage and diseases (Franke et al. 2015). This means that the increasing scrub and forest colonisation of the bare fell region is going to take place at different rates in different places.

The advancing of the Scots pine (*Pinus sylvestris*) timberline in Finnish Lapland began more than a hundred years ago as the climate warmed after the Little Ice Age, but the rate of migration has been rather slow (Holtmeier et al. 2003; Sutinen et al. 2011). The conditions for Scots pine dispersal have improved in Finnish Lapland and appear to be improving further as summers become warmer (Juntunen and Neuvonen 2006; Aakala et al. 2014; Matías and Jump 2014; 2015; Figure 4.67). The findings of Holtmeier et al. (2003) do not, however, support the view of forests rapidly climbing up fells in Lapland. Besides temperature, the success of the Scots pine in the treeline ecotone is affected by several factors, such as soil, wind and grazing (Holtmeier et al. 2003; Sutinen et al. 2011; Matías and Jump 2015). Studies have been published in the 2000s on the Scots pine and its regeneration in the treeline ecotone, but these have not examined the potential rate of advance of the species in the future. Projections are difficult to make as there are numerous outstanding issues and uncertainties such as the differing climate projections given by the various climate models. Even with further warming of the climate, factors such as a harsh microclimate, drought and reindeer grazing may override the effects of decades of gradual increase in temperatures (Holtmeier et al.

2003; Juntunen and Neuvonen 2006). Changes in soil and vegetation caused by reindeer grazing may affect seed germination, seedling emergence and seedling growth in many ways (Juntunen and Neuvonen 2006; Aakala et al. 2014). For example, the grazing of mountain birch forests may slow down the advance of the Scots pine timberline as Scots pine seedlings benefit from the shelter provided by birches (Juntunen and Neuvonen 2006).

The proximity of the Bothnian Bay has a strong impact on the location of the timberline on fells: the closer to the Bothnian Bay a fell is, the lower the timberline. The fell timberline ascends the further east and north the site is located. The above-mentioned phenomenon explains why the vegetation of isolated southern fells is boreal in nature. Wintery factors, especially crown snow load, have a strong impact on the location of fell timberlines up to the latitudes of the southern parts of the Saariselkä and Pallastunturi fells (Norokorpi and Kärkkäinen 1985; Norokorpi 1994). Where soil fertility enables the success of the Norway spruce (*Picea abies*), it forms the timberline as a tree species that is more enduring than the birch and the Scots pine. On the Lommoltunturi fell located in the Pallas-Yllästunturi National Park, the Norway spruce timberline has been at an exceptionally low altitude. According to Sutinen et al. (2012) the elevational shift of the Norway spruce timberline has been 90 metres in 120 years. The upward migration of the Norway spruce is restricted by physical-chemical properties of the soil (Ca and Mg concentrations and lowering of the Ca:Al ratio towards the higher elevational gradients). In addition to this, cryoturbation (impacts of freezing and thawing; frost churning) and solifluction (water-saturated soil flowing down the slope and forming a solifluction terrace and lobes) processes and the absence of snow cover at higher elevations on fells restrict the spread of the Norway spruce (Sutinen et al. 2012).

Changes taking place at the Norway spruce and Scots pine timberline were studied over a 26-year period (1983–2009) in 13 different areas of Finnish Lapland (Franke et al. 2015). For the Norway spruce, there was a significant increase in the volume of tree stock (m^3/ha) and in stem number (saplings, seedlings and trees per hectare). The Norway spruce requires more favourable conditions for regeneration than the Scots pine but, following regeneration, Norway spruce seedlings are more resistant than Scots pine seedlings to pests and severe abiotic conditions such as crown snow loading. Despite an increase in Norway spruce seedlings thanks to good seed years, any actual upward migration of the Norway spruce timberline has, however, so far only been observed at anomaly sites such the Pallas area on the western slope of the Lommoltunturi fell (Sutinen et al. 2012). According to Franke et al. (2015), volume growth was also observed in Scots pines, but there was no increase in stem number. The conclusion of the study was that the increase in the Norway spruce and Scots pine growing stock and seedling emergence was probably due to the lengthening of the growing season and the increased atmospheric CO_2 concentration (Franke et al. 2015). Degree days and precipitation increased during the study period in Lapland especially in the 1994–2013 period compared with the long-term annual mean values for the 1977–2013 period (Finnish Meteorological Institute 2014).

Snowbeds and snow patches shrinking

Fell habitat types most sensitive to climate change are those that are dependent on snow and ground frost, such as the habitat type group of snowbeds and snow patches. The occurrences of these habitat types are very small in area and decline rapidly if the snow-covered period becomes shorter. Kivinen et al. (2012) analysed the impacts of topographical and climate factors on July–August snowbeds and snow patches in the Käsivarsi area of northwestern Finnish Lapland. The snowbeds and snow patches were usually located on northern and eastern slopes of fells at altitudes of 900–1,000 m a.s.l., and their occurrence was strongly related to elevation and topography. Snowbeds and snow patches are often formed in fell valleys, hollows and gorges whose topography and microclimate favour snow accumulation. The researchers observed major fluctuations between years in the occurrence of snowbeds and snow patches. The reduction in snowbeds and snow patches was connected not only to low snowfall-to-rainfall ratios but also to increased annual mean temperatures, particularly spring and early winter temperatures, which indicates earlier melting of snow (Kivinen et al. 2012). Halti is one of the few fells in Finland with snow patches and snowbeds that melt very late. Satellite image analyses over the 1984–2016 period show that the coverage of snowbeds and snow patches has halved since the 1980s. According to the modelling, snow patches are projected to disappear entirely from the Halti area before 2040, while the total area of snowbeds that melt during August will decrease to 1.2 km^2 (Table 4.11). (Niittynen 2017)

In the future, earlier melting of snow will have an adverse effect on plant species and communities that are dependent on snowbeds and snow patches, as they are adapted to low temperatures and short growing

Table 4.11. Total area (km^2) of snowbeds in the Halti area based on aerial photo interpretation (1980 and 2000) as well as modelling and projections (2020 and 2040) during various study periods (July = areas that melt during July, August = areas that melt during August, September = areas that melt after the beginning of September or that never melt) (Niittynen 2017).

	1980	2000	2020	2040
July	25.4	19.2	15.0	10.8
August	5.0	3.2	2.0	1.2
September	1.4	0.8	0.3	0

Figure 4.68. The "snow fence" effect of a mountain birch forest on snow melting and albedo. Kaldoaivi Wilderness Area, Utsjoki. Photo: Arto Saikkonen.

seasons. Snowbed species suffer not only from major temperature fluctuations in the spring and soil drying in the summer but also from competition by species living in surrounding, more productive sites (Björk and Molau 2007). Climate change does not, therefore, only threaten directly snow-dependent species but also the occurrence and diversity of plant species living in humid high-altitude microhabitats. The most threatened snowbed plants are mosses and herbaceous plants (graminoids, sedges and rushes). As global warming advances, plant communities of snowbeds and snow patches will transform into mountain heaths and meadows, reducing biodiversity in the fell area.

Interaction between climate change and grazing

The state of tundra and fell vegetation is regulated strongly by the interaction between climate change and grazing by herbivores, especially reindeer (Olofsson et al. 2009; Elmendorf et al. 2012; Olofsson et al. 2014; Christie et al. 2015; Myers-Smith et al. 2015; Maliniemi et al. 2018). Intensive reindeer summer grazing slows down dwarf shrub, scrub and forest expansion as reindeer feed especially on plant species that are easy to digest, such as birches and willows (Herder et al. 2008; Pajunen et al. 2008; Ravolainen et al. 2014; Christie et al. 2015). The remaining vegetation has a major impact on surface energy exchange, soil temperatures, decomposition rates, nitrogen cycling and carbon storage (Chapin et al. 2004; Myers-Smith et al. 2011).

Vuorinen et al. (2017) repeated a vegetation transect study conducted in 1976 in Darju, Enontekiö, northwestern Finnish Lapland, spanning from woodland to a summit (465–722 m a.s.l). They observed that the mountain birch timberline had not moved in 40 years despite the climate warming. Arctic species had declined and some boreal species had spread to the treeless fell area which originally had scarce vegetation. Between 1964 and 2013, the annual mean temperature in Kaaresuvanto had increased by around 2 ºC, growing degree days (i.e. the sum of average daily temperatures above +5 ºC) by 120 degrees per degree day and the January–February mean temperature by 3 ºC. Annual precipitation had increased by 60 mm, but there were no clear changes in snow cover thickness. According to researchers, key reasons for the non-movement of the mountain birch timberline include reindeer summer grazing as well as the increased abundance of dwarf shrubs, especially the crowberry (*Empetrum nigrum*) and its inhibitory effect on the sexual reproduction of trees (see González et al. 2015; Vuorinen et al. 2017). Maliniemi et al. (2018) studied vegetation changes in multiple fell areas between the 1960s and the 2010s and also observed increased abundance of the crowberry on snow-protected heaths as well as a decrease in lichens throughout the study area. Neither Vuorinen et al. (2017) nor Maliniemi et al. (2018) observed any large-scale scrub or forest colonisation (*Betula* spp., *Salix* spp., *Juniperus communis*) in spite of the warming of the climate. The clearest changes were observed in the boreal forest-tundra ecotone where the abundance ratios of many species have changed on snow-protected heaths, and the coverage of the crowberry and other species, including the moss *Pleurozium schreberi*, had increased significantly.

Effects of reindeer grazing on snowmelt, surface albedo (reflectivity) and energy balance have been studied on the basis of satellite data analyses both in a reindeer summer grazing area located in the mountain birch zone in Finland and in an area in Norway where no summer grazing took place (Cohen et al. 2013). The Normalized Difference Vegetation Index (NDVI), which is calculated on the basis of satellite imaging or other remote sensing data, was used to quantify vegetation in the test areas. The NDVI is based on radiation reflected by vegetation. The chlorophyll pigment in plants absorbs visible light but, due to their cell structure, plant leaves mainly reflect near-infrared radiation. According to the results, late-winter albedo in the reindeer summer pasture area is higher due a lower NDVI value than in the ungrazed area, as grazed shrub vegetation does not protrude above the snowpack. This is why in the summer pasture snow melts more slowly in late winter and the area absorbs less solar radiation than the ungrazed area (Cohen et al. 2013).

Further research into the topic is required as, on the other hand, field observations support the view that more snow accumulates in areas such as mountain birch forests than on open sites (the "snow fence" effect, Figure 4.68) and snow stays there longer than in treeless areas even though mountain birches themselves absorb radiant energy. Although the summer grazing of reindeer reduces climate change-induced scrub expansion and increases albedo by slowing the melting of snow, at the same time it also reduces the quantity of reindeer lichens (Kumpula et al. 2011; 2014), which in turn lowers the albedo of snowless ground. Consequently, further research data is needed to be able to conduct a comprehensive evaluation of the effects of reindeer grazing, geometrid moth damage and climate change on albedo and on the progression of the impacts of climate change.

Fell plants may benefit from a moderate rate of herbivore grazing as it curbs biomass growth and interspecific competition of plants caused by climate change, maintains microhabitats of fell species established on a site and boosts the growth and reproduction of fell species and, consequently, their diversity (Björk and Molau 2007; Kaarlejärvi et al. 2013; 2015; Eskelinen et al. 2016b). Experimental manipulations conducted on the Iso-Jehkas fell, Kilpisjärvi, Finland (750 m a.s.l.) showed that, as the climate warms, mammalian herbivory and low soil fertility protect species established on the fell against upward range expansion of lowland plant species and declines in diversity caused by them (Kaarlejärvi et al. 2013; 2015; Eskelinen et al. 2016a). Experimental studies by Kaarlejärvi et al. (2017) in the same area showed that herbivory reverses the impact of experimental warming of soil on plant species diversity. In the presence of herbivores (reindeer, Norwegian lemmings (*Lemmus lemmus*) and grey-sided voles (*Myodes rufocanus*)), warming increases species diversity, whereas in the absence of herbivores diversity declines.

Frost damage may become more prevalent

Winter temperatures are projected to rise, the snow-covered period to shorten and mild winter periods and formation of ice on the surface of the ground to increase further in Finland's fell areas, too (Kivinen et al. 2012). Loss of protective snow cover due to mild periods and rapid drops in temperature to subzero levels may cause considerable and extensive frost damage to vegetation. For example, in December 2007 there was a 12-day period in the northern Norwegian-Swedish border region during which temperatures fluctuated between +2 ºC and +10 ºC and melted the snow over an area of 1,400 km2. This resulted in the vegetation of an area representing an *Empetrum* mountain heath in terms of its habitat type first being exposed to temperatures that were exceptionally high for the time of year and then to low temperatures in the absence of snow cover. However, the *Empetrum* mountain heath recovered relatively rapidly from the frost damage. Should events like those described above recur on an annual basis, more serious damage might be seen in vegetation, resulting in knock-on effects on higher trophic levels, including on rodents and reindeer (Bokhorst et al. 2009; 2012). In addition to low temperatures and major temperature fluctuations, loss of snow cover also exposes plants to freeze-induced dehydration, repeated freeze-thaw cycles and erosion caused by ice particles transported by wind (Tahkokorpi et al. 2007; Taulavuori et al. 2011).

Frost heaving may decrease

In this context, 'ground frost' refers to a hard layer of soil formed when water contained by soil freezes. When the freezing or thawing of the soil involves soil movement, displacement of rocks or changes in the physical properties of the soil, such as changes in bearing capacity, the phenomenon is referred to as 'frost heaving'. There are four types of ground freezing: 'Surface frost' (or cryoturbation) and 'cavity frost' (created on walls of cavities in the surface layer of soil) are small in scale and do not cause soil movement. In contrast, frost heaving is caused by 'massive soil frost' occurring in gravel, sand and peat and 'layered soil frost' in till, silt and clay soils. Layered soil frost is created in soil types whose water permeability is low.

Ground frost is created when soil temperature drops below the freezing point of water. Ice crystals first begin to form in places with free interstitial water. As the water freezes and its volume consequently increases, there is no escape route for the water. The ice formed lifts the soil above it, as this is the path of least resistance. New water flows around the ice crystals as, within the ground, water flows towards the thermal gradient from

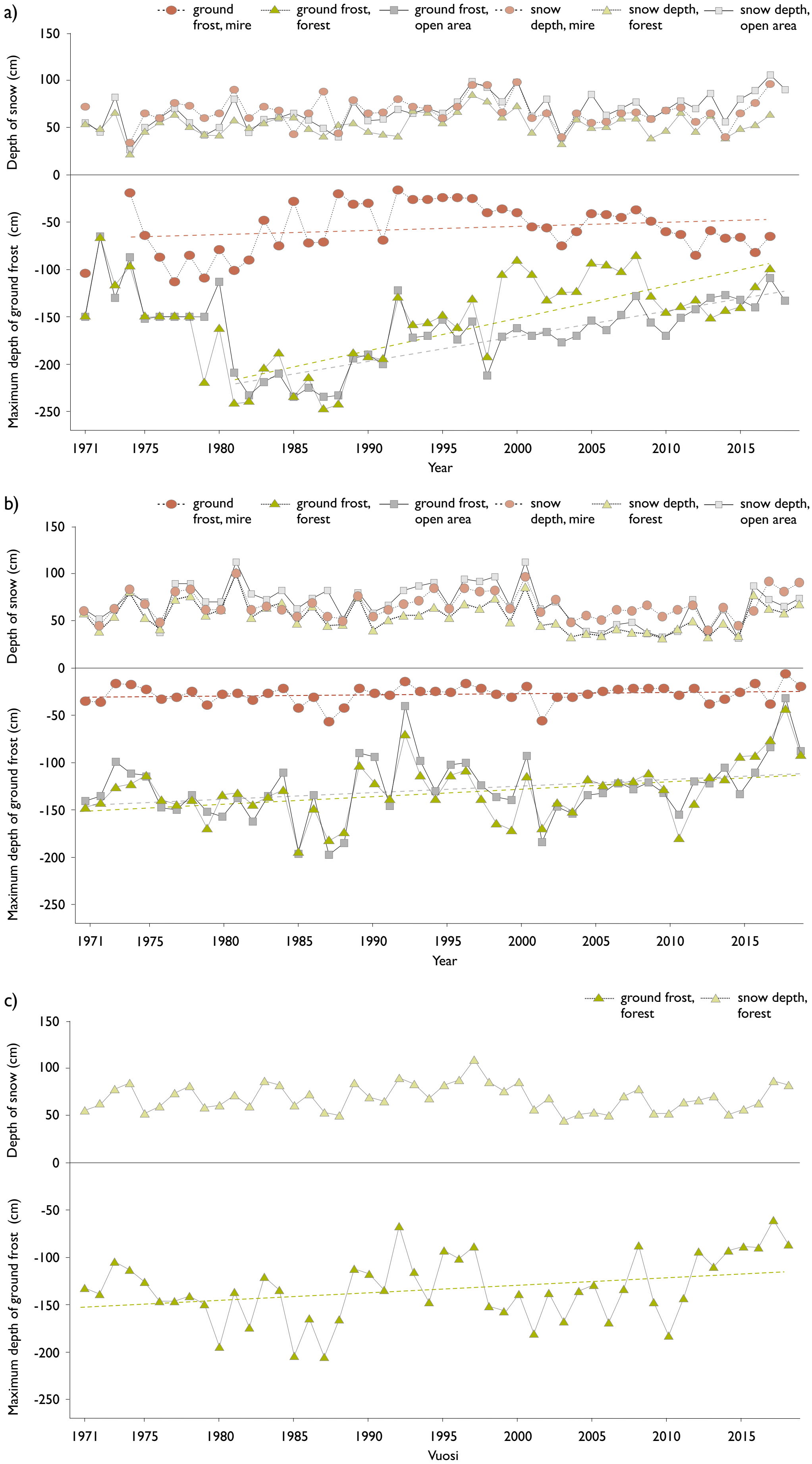

Figure 4.69. Maximum depth of ground frost and snow at three ground frost stations in Finnish Lapland: a) Inari, Angeli, b) Inari, Nellim and c) Utsjoki, Kevo, where monitoring started in 1971. The monitoring sites are located in different environments: open area, forest and mire. The regression lines illustrate the ground frost depth trends over time. Data source: Finnish Environment Institute, Freshwater Centre.

the warmer to the cooler zone. Ice crystals grow larger and form in the soil an ice lens or band which thickens as new water flows in. As the thickness of the freezing soil layer increases, ice bands are created at multiple levels. The volume of water stored in them is many times that found in unfrozen soil. The soil surface and stones are lifted by an amount equalling the combined thickness of the ice lenses. Besides air temperature, the speed of ground frost formation is affected by the thermal conductivity of the soil. Stones contained by the soil are good conductors of heat. They also conduct cold and accelerate the freezing of soil.

The depth of ground frost varies widely from year to year depending on how cold the winter is and on the depth of snow cover as well as on the soil type, moisture level and vegetation cover. Ground frost depth is greatest in dry till soils and in coarse mineral soils and smallest in fine-grained mineral soils and in mires. In Lapland's fell areas the average ground frost depth is 210–230 cm.

Ground frost thawing begins both from below the frost layer and from the surface. Thawing is faster at the surface than in the deeper layers. Due to the impact of unthawed ground frost underneath, water released through thawing is unable to sink in the soil. Instead, it is absorbed into the surface layer of the soil, which then becomes saturated with water. As thawing continues, the surface layer of the soil gradually dries, but there is still a water-saturated layer of soil between the surface and the unthawed bottom layer of ground frost, which causes frost heaving. When ground frost thaws, the soil and stones raised by it move downwards. Often the stones lifted by frost heaving do not return to the same location in which they were in the autumn. Instead, they stay higher up as water-saturated soil has flowed in the space that used to be ice underneath the stones. This is how stones gradually rise from deep underground layers to the soil surface and become enriched there as the stone layer. In Lapland's fell areas, the ground frost formation period is from the beginning of November until the end of April and the ground frost thawing period is from the end of April until the end of June.

Climate change gradually results in the thinning of the ground frost layer and the shortening of the ground frost period (Jylhä et al. 2009; Kellomäki et al. 2010; Rasmus et al. 2015; AMAP 2017). According to Jylhä et al. (2009), in Lapland the ground frost layer is projected to thin in snowless areas by around a quarter by the middle of the century (2040–2069) and by as much as 30–40% during the second half of the century (2070–2099). As the climate warms further, ground frost will no longer reach the same depths as today. The amount of ground frost will, however, vary from year to year in the future, too, depending on winter temperatures and snow cover thickness. According to measurements carried out in Abisko, sub-arctic Sweden, the length of the ground frost period has shortened both in the autumn due to later freezing and in the spring due to earlier melting (Schmidt 2011).

According to long series of ground frost measurements conducted in Northern Lapland, there is major annual variation in the maximum depth of ground frost. Data from measuring points located in open and forested areas in Nellim, Inari, and Kevo, Utsjoki, shows a statistically significant trend indicating the thinning of ground frost: the annual maximum ground frost depth decreased over time from by 0.67–0.81 cm per year during 1971–2018 ($p < 0.05$ for all regressions). In Angeli, Inari, too, the maximum ground frost depth decreased over the 1981–2018 period (Orvomaa 2015), but the trend is not statistically significant when the longer period of 1971–2018 is examined (Figure 4.69).

According to modelling by Aalto et al. (2017), both the periglacial realm – the areas adjacent to glaciers – and cryogenic land surface processes (LSPs) controlled by ground frost and permafrost are projected to disappear almost entirely from Northern Europe due to climate change. Cryogenic processes include cryoturbation (mixing of soil layers due to freezing and thawing), gelifluction (downslope movement of soil taking place on top of permafrost), nivation (local erosion taking place in snowbed environments) and high palsa peat mounds which develop through permafrost heaving. The projection suggests that, even with the most optimistic CO_2 emissions scenario (RCP 2.6), the current periglacial processes would decrease by up to 72%. If the most pessimistic CO_2 pathway (RCP 8.5) is realised by 2100, the climate of Northern Europe will no longer be suitable for palsa formation or other active periglacial LSPs. The disappearance of periglacial processes would be particularly severe in high-latitude low-relief continental interiors, and these processes would only exist at high elevations (Aalto et al. 2017).

Climate change and pest insects

It has been historically typical of mountain birch forests in Northern Europe to experience cyclical population fluctuations of geometrid moths (Tenow 1972; Babst et al. 2010). On the broad scale, peak densities have recurred very regularly at intervals of around 9–11 years in the oceanic parts of the mountain birch zone but less regularly in the more continental areas such as Finnish Lapland (Neuvonen et al. 1999; 2005). Not all population peak densities lead to total defoliation of birch forests, and it is not yet known which factors affect the intensity and locations of the peaks. At the local level, the duration of peak densities resulting in the complete defoliation of a birch forest is usually only 2–3 years (Tenow et al. 2007), but consecutive peaks of the autumnal moth (*Epirrita autumnata*) and the winter moth (*Operopthera brumata*) may lead to longer outbreaks, too (Klemola et al. 2008).

In the mid-1960s, birches were defoliated across an extensive area in Utsjoki, Finland, and the affected mountain birch forests have not really recovered from this (Kukkonen 2002). Instead, a large proportion of the damaged area has turned into a secondary mountain heath (Sihvo 2002). Large-scale damage caused by the autumnal moth in Finnish Lapland took place in Enontekiö between 2004 and 2006 (Kopisto et al. 2008), and there was an outbreak of the autumnal as well as the winter moth between 2006 and 2008 in Utsjoki (Mikkola 2008). On average only around one in five of the birches

Figure 4.70. Damage caused by the winter moth (*Operophtera brumata*) in the 2000s in the Kaldoaivi Wilderness Area, River Vetsijoki, Finnish Lapland. The photograph shows that extreme subzero temperatures lower in the valley have killed the moth eggs and the mountain birch stands have been spared. Photo: Arto Saikkonen

on the experimental site studied in Enontekiö died and the birch forests have recovered fairly well (Kopisto et al. 2008) but, in the eastern part of Utsjoki, mountain birch forests have suffered major damage over an extensive area (Kauppinen 2008; Santonen 2011). The most recent observations of winter moth damage are from 2017 from the Muotkatunturi Wilderness Area.

Global warming promotes outbreaks of pest insects such as the autumnal and the winter moth on the mountain birch (Jepsen et al. 2008; Karlsen et al. 2013) as well as outbreaks of diprionid sawfly defoliators (Diprionidae; conifer sawflies) on the Scots pine (Neuvonen et al. 1999). With mild winters becoming common, damage to mountain birch forests may become more widespread and occur more frequently (Virtanen et al. 1998; Ammunét et al. 2012; 2015) as the overwintering of the eggs of birch-feeding moths becomes easier. This may increase mass occurrences of moth larvae that destroy mountain birch forests in continental areas (Neuvonen et al. 2005).

Autumnal and winter moth damage results in the rapid shift especially from nutrient-poor, *Empetrum*-dominated mountain birch forests to ones dominated by the wavy hair-grass (*Avenella flexuosa*) (Jepsen et al. 2013; Karlsen et al. 2013). The combined effect of moth damage and intensive reindeer grazing in the summer has in many areas caused significant reductions in mountain birch stands and resulted in the creation of secondary mountain heaths (Chapin et al. 2004). Climate change may, however, to some extent improve the recovery capacity of mountain birches (Huttunen et al. 2012; 2013), but the combined effect of insect damage and reindeer grazing in turn slows their recovery (Tenow et al. 2005; Olofsson et al. 2009).

Damage caused by autumnal and winter moths in Finnish Lapland has usually been limited to the upper slopes of fells. There are two reasons for this: (1) in very low winter temperatures, the coldest air accumulates at the bottom of valleys and kills overwintering moth eggs (Tenow and Nilssen 1990; Virtanen et al. 1998), and (2) the efficiency of the natural enemies of the larvae (e.g. the parasitoid wasp *Eulophus larvarum*) is higher in valleys which are warmer in the summer (Virtanen and Neuvonen 1999). When the climate warms, the area susceptible to geometrid moth damage expands as its lower boundary descends on fell slopes (Virtanen et al. 1998; Ammunét et al. 2012; Figure 4.70). If the damage is strong enough to kill the birches, the consequence may be that the mountain birch timberline moves downward as winters become warmer. It is, however, difficult to produce precise forecasts as variation in microclimates caused by topography is very high (Pepin et al. 2009;

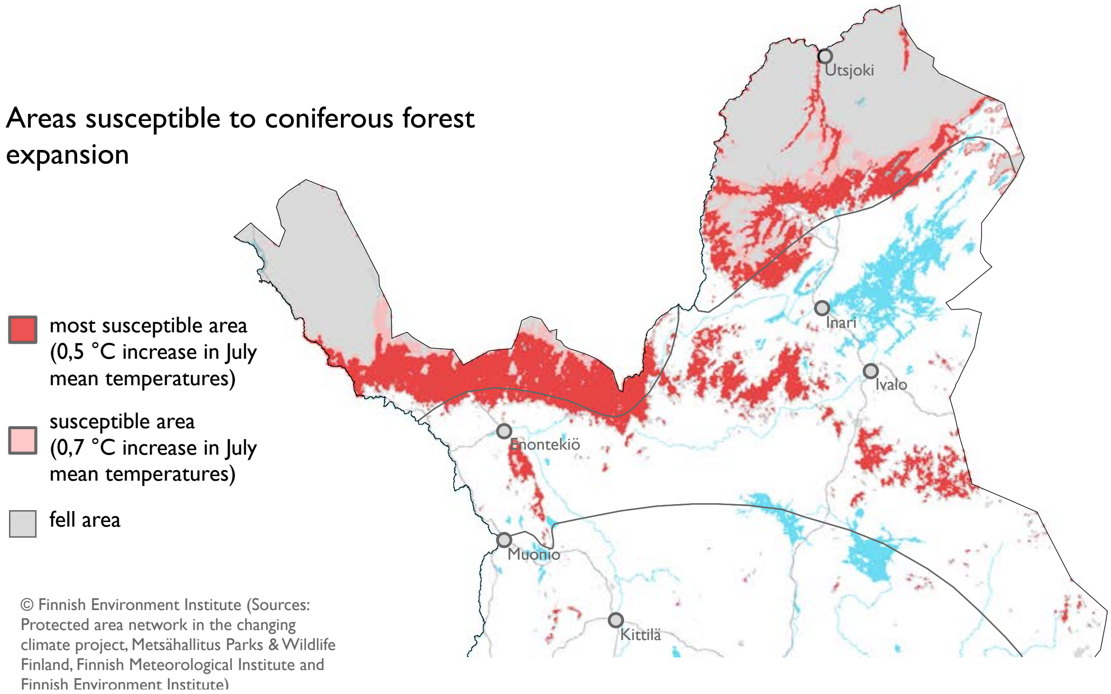

Figure 4.71. Areas most susceptible to coniferous forest expansion on the basis of modelling.

Suggitt et al. 2011; Neuvonen and Virtanen 2015). Correspondingly, damage caused by the European pine sawfly (*Neodiprion sertifer*) in Saariselkä, Finnish Lapland, has slowed the upward movement of the Scots pine timberline (Niemelä et al. 1987; Franke et al. 2015).

Fell area susceptibility to change modelled using July mean temperature

The size of the fell area – the oroarctic conifer-free zone – has varied in the postglacial period in line with climate fluctuations. During the Atlantic period around 5,000–8,000 years ago, Scots pine (*Pinus sylvestris*) forests occurred almost throughout the northernmost areas of Finnish Lapland (Ylä-Lappi and Käsivarsi) excluding the highest fells and mire areas (Kultti et al. 2006). If climate change advances in accordance with forecasts, conifers will slowly colonise new areas and the timberline will migrate both further up north and further up slopes. The movement of the timberline is strongly dependent on local topography, wind conditions, snow levels, soil nutrition, humidity and sorting, with areas which are low-lying and favourable for tree regeneration being the first to be forested in patches (Väliranta and Virtanen 2012).

The locality and sensitivity of possible timberline migration was tested by using logistic regression to examine dependence between July mean temperature (1981–2010) and the size of the fell area. The explanatory variable used was a temperature value determined for centre points of compartments from Finnish protected area biotope information system data (SAKTI 2017) and the explained variable was binary 0/1 data on the compartments belonging to the fell area. The limiting value provided by the model for the fell area is the July mean temperature of +12.4 °C. Altering the explanatory variable of the model (July mean temperature) enabled the examination of to which areas the possible migration of the conifer timberline will advance most easily. Figure 4.71 illustrates the advancement of coniferous forests following increases of 0.5 °C and 0.7 °C in the July mean temperature. The method is described in greater detail in the publication by Mikkola and Virtanen (2006).

On the basis of the modelling, the flat areas with a large number of sorted soil types in the eastern parts of Enontekiö as well as the mire-rich zone north of Lake Inari appear to be the most sensitive as regards a decline in the size of the fell area. In other words, in these areas even a reasonably small permanent temperature rise may change the conditions in favour of coniferous trees. It should be remembered, however, that this model is a so-called climate equilibrium model. In reality, tree stands will not reach the distribution pursuant to the model for at least a hundred years or even more due to a variety of edaphic and biological factors such as herbivory delaying tree regeneration and growth.

Black carbon accelerates climate change

Besides increasing rainfall in the winter, the albedo (reflectivity) of snow and ice is reduced by soot particles. This soot or black carbon also absorbs solar radiation and therefore directly heats the atmosphere. Black carbon enters the atmosphere from household combustion of wood and other biomass, road transport, agricultural and construction machinery as well as industrial and energy installations. Black carbon is also created through the burning (flaring) of unwanted oil and gas in oil and gas fields. Forest fires also cause black carbon emissions. Black carbon remains in the atmosphere from a few days to weeks, which is why it may be transported thousands of kilometres from the emission source (Ruppel 2015a; 2015b; Hildén et al. 2017; Jylhä et al. 2017).

It is estimated that 20–25% of warming in northern areas is currently caused by black carbon. Its impact in the north is particularly significant because it falls on the surface of snow and ice. Black carbon does not reflect sunlight. Instead, it absorbs it, becomes warmer and melts ice and snow.

The adverse impacts of black carbon are especially strong in the spring and summer when sunlight levels are high in the north. Black carbon ends up in the north in air masses transported from the south, but emissions originating from the north play a significant role, too. Around a third of the warming of the Arctic region is caused by black carbon emitted by the Arctic Council Member States themselves, although their emissions only account for 6% of the global emissions. (AMAP 2015; Hildén et al. 2017; Klimont et al. 2017)

Utilising reindeer herders' local knowledge

As reindeer herders often have decades of experience, gained since they were children, on the year-round natural conditions of their reindeer herding cooperative's area, a questionnaire was used to collect their local knowledge about weather conditions and climate and the impacts of these on nature and reindeer husbandry (Turunen et al. 2017b; 2017c). Empirical local knowledge and observations of weather and natural conditions are valuable as these conditions have a direct impact on nature-based livelihoods. Combining local and scientific knowledge provides a deeper understanding of the interactions between nature and humans (Helander-Renvall and Markkula 2011; Vuojala-Magga et al. 2011; Berkes 2012; Markkula and Helander-Renvall 2014; Turunen et al. 2016; Horstkotte et al. 2017).

The online questionnaire aimed at reindeer herders was distributed by email to reindeer herders of reindeer herding cooperatives as well as via the website and the magazine of the Reindeer Herders' Association (Poromies). Respondents were requested to evaluate, on a scale of 1–5, statements given for each season of the year about weather, climate and vegetation as follows: 1 – I have observed change(s), 2 – I have observed change(s) to some extent, 3 – I have not observed any change(s),

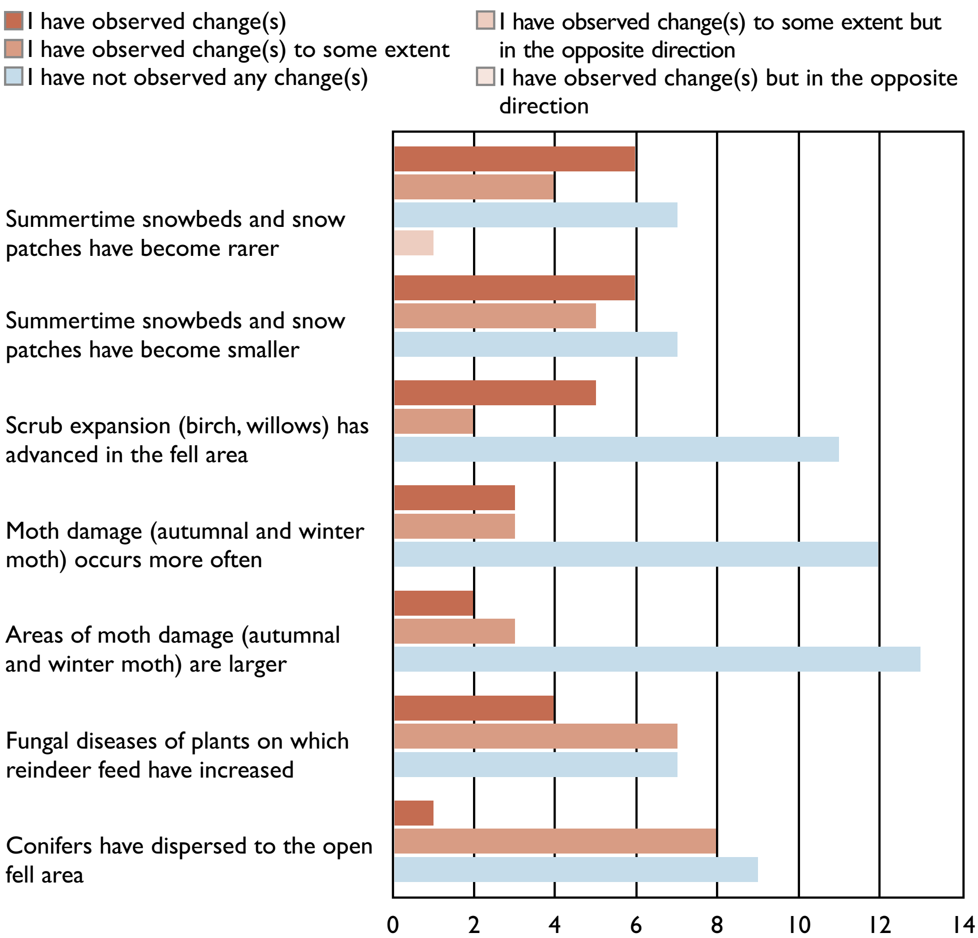

Figure 4.72. Responses to questions concerning fells in the questionnaire collecting local knowledge of reindeer herders from reindeer herding cooperatives in the fell area (18 responses).

4 – I have observed change(s) to some extent but in the opposite direction or 5 – I have observed change(s) but in the opposite direction. Respondents were also able to provide more detailed descriptions of any changes and the impacts of these on reindeer husbandry in their own reindeer herding cooperative. The questionnaire covered the past 30 years, but young reindeer herders could also consider any changes observed by them over their entire lifetime.

Responses were received from 90 reindeer herders, of whom 18 were from reindeer herding cooperatives in the fell area (Ivalo, Hammastunturi, Kaldoaivi, Käsivarsi, Lappi, Muonio, Näkkälä, Paistunturi and Sallivaara) and 72 from cooperatives in forest areas. The average age of the respondents was 43. A total of 72% of them were professional and 28% part-time reindeer herders.

Responses received from reindeer herders from the fell area were compared with the long-term observations from weather stations located in Northern Lapland (Kilpisjärvi, Näkkälä, Palojärvi, Alamuonio, Kevo, Pokka, Saariselkä and Ivalo) (Virtanen et al. 2010; Rasmus et al. 2014, Lépy and Pasanen 2017). In addition, observations from the most continental weather stations located in Northern Norway (Sihccajavri, Kautokeino and Karasjok) were used (Vikhamar-Schuler et al. 2010; 2016; Kivinen et al. 2017) as their climate is to a great extent affected by the same weather phenomena as on the Finnish side of the border. Time series from the weather stations vary from a few decades to a hundred years, which affects the identification of any trends.

According to observations by reindeer herders from cooperatives located in the fell area, summer weather has become more unstable, precipitation rates have increased and heavy rainfall is more common. On the other hand, there were no observations of summers becoming warmer, drought or summer sleet or hail becoming more common or cold periods becoming rarer (Turunen et al. 2017b; 2017c). According to weather station observations made in the areas of the fell cooperatives, summers have become warmer in several locations but there has not been any clear change in summer precipitation rates in areas other than the southern fells (Virtanen et al. 2010, Lépy and Pasanen 2017; Maliniemi et al. 2018).

Altogether 61% of the respondents had observed a reduction in the size of snowbeds and snow patches in the summer and 56% had observed that these habitat types had become rarer (Figure 4.72). According to a respondent, "Long periods of heavy rainfall melt the snowbeds." The majority of reindeer herders of the reindeer herding cooperatives of the fell area had not observed changes in the extent or prevalence of geometrid moth damage in mountain birch forests compared with past decades. On the basis of the responses, there were no clear differences compared with the past in scrub (birch, willow) expansion to fells, either. The significance of reindeer emerged in responses: "The reindeer prevent scrub colonisation." Reindeer herders had not observed changes in the spread of conifers to open fell areas (Figure 4.72). In some areas, however, conifer expansion had been observed: "The Scots pine has spread upwards. Petsikko is an example of these sites. You can see today's situation there. Just take a look at aerial photos and you can see the pines."

The majority of the respondents were of the opinion that the subzero temperature season begins, ground frost forms and snow cover appears later in the autumn than before. Autumn precipitation rates have not changed noticeably according to the responses or weather station measurement data, either. Reindeer herders from fell area cooperatives were almost unanimous in their view that winters have become warmer and the number of subzero temperature days has decreased. They also reported that unstable winter weather, crown snow load formation in trees and winter rain had become more common. It was the view of reindeer herders that these days the subzero temperature period ends, snow melts and snowless patches appear earlier and the summer growing season begins sooner than some decades ago. These observations are as a general rule in line with long-term meteorological measurements made in northern parts of Finland and Norway. According to Kivinen et al. (2017), there has been a significant decline in extremely cold weather events in all seasons in northern Fennoscandia. Reindeer herders' observations concerning increased winter precipitation and commonness of rain in the winter are also in line with observations from weather stations located in Northern Finland and Northern Norway (Vikhamar-Schuler et al. 2010; Rasmus et al. 2014; Kivinen et al. 2017; Lépy and Pasanen 2017). The thickness of the snow cover has not changed markedly on the basis of reindeer herders' responses or weather station data.

According to reindeer herders from cooperatives in the fell area, the formation of basal ice and icy layers in snow has not increased clearly, whereas respondents from forest area cooperatives were almost unanimously of the opposite view (Turunen et al. 2017b; 2017c). According to Rasmus et al. (2018), extensive basal ice formation occurred in the reindeer husbandry area 16 times during the 1948–2017 period. Basal ice was classified as extensive when 20% of the reindeer herding cooperatives reported basal ice in their annual report of operations. The fact that 16 of these basal ice winters have occurred over the past ten years may indicate that the phenomenon is becoming more common (Rasmus et al. 2018). Several other studies of the increased prevalence of weather conditions preceding basal ice formation may also suggest this (Vikhamar-Schuler et al. 2010; Rasmus et al. 2014; Lépy and Pasanen 2017).

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5.1
Numbers of habitat types examined

A total of 414 assessment units were evaluated in the threat status assessment of habitat types, of which 388 are habitat types or habitat complexes classified at the lowest – most specific – classification level and 26 habitat types classified at the group level. Group-level assessments took place especially in cases where a habitat type group corresponds to a habitat type of the Habitats Directive or another commonly used classification unit.

This summary only covers habitat types and habitat complexes at the lowest hierarchical level, and any overlapping group-level or habitat type-level assessments are not included in the calculations (Table 5.1). In this context, the general concept of 'habitat type' means both habitat types and groups formed by them as well as habitat complexes.

The number of assessed habitat types varies by main habitat type group from 34 forest habitat types to 69 mire habitat types (Figure 5.1). For most of the habitat type groups, only minor changes have taken place in classification. Since the previous assessment, the biggest further specifications in the classification have taken place in underwater habitat types of the Baltic Sea, of which only 12 were distinguished and assessed last time (Figure 5.2). On the other hand, the classification of heath forests has been simplified considerably by

Table 5.1. Number of habitat types included in the threat status assessment in the whole country and in Southern and Northern Finland. 'All those assessed' contains all of the habitat types and habitat complexes classified under the threat status categories (CR, EN, VU, NT, LC, DD) as well as group-level assessments which, to avoid overlaps, have been removed from 'Those at the lowest level of classification assessed'. The summaries in Chapter 5 only cover habitat types and habitat complexes at the lowest level of the classification.

	Number of habitat types		
	Whole Finland	Southern Finland	Northern Finland
All those assessed	414	340	279
Those at the lowest level of classification assessed	388	317	253

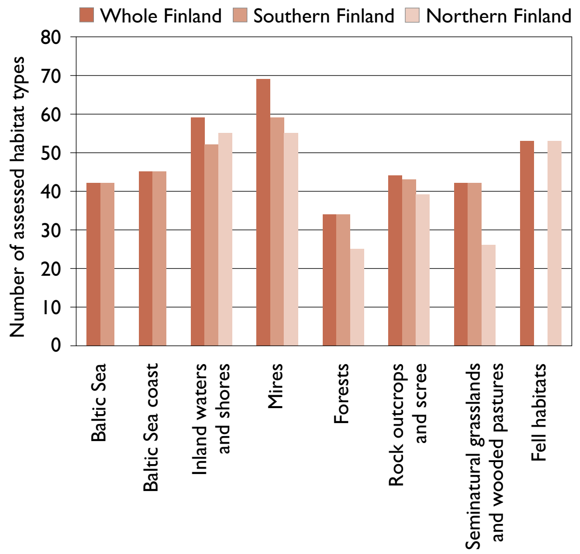

Figure 5.1. Number of assessed habitat types by habitat type group in the whole country and in Southern and Northern Finland. The figures also include Data Deficient (DD) habitat types.

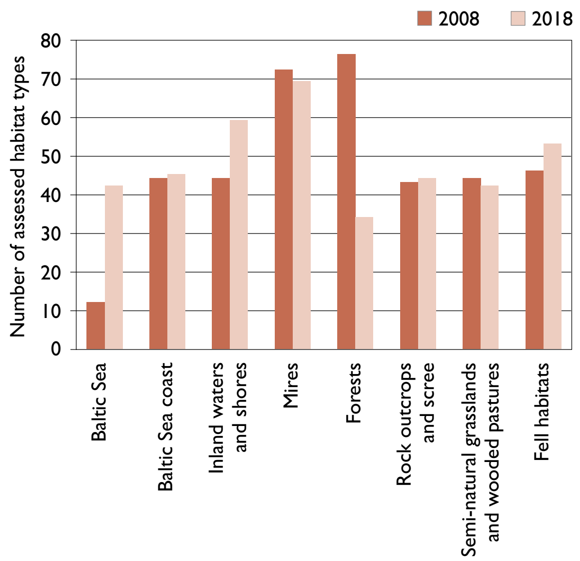

Figure 5.2. Number of assessed habitat types by habitat type group in the whole country in the previous assessment (2008, Raunio et al. 2008) and in this assessment (2018). The figures also include Data Deficient (DD) habitat types. The result summaries were provided without the DD category in the previous assessment.

merging classes that used to be separated on the basis of dominant trees and succession stages into broader assessment units. The total number of assessed habitat types is now almost the same as in the previous assessment, when 381 units were assessed.

5.2
Breakdown of habitat types into IUCN Red List categories

Of the total number of assessed habitat types, those classified as threatened (CR, EN or VU) accounted for 48% in the whole country, 59% in Southern Finland and 32% in Northern Finland (Figure 5.3, Table 5.2). There are 57 (15%) of the most severely threatened – Critically Endangered (CR) – habitat types in the whole country, and 40 of these are seminatural grasslands or wooded pastures. Other habitat types assessed as CR include coastal dune types, streams and rivers of southern clay-dominated catchment areas, rich fens and fell habitat types.

At the nationwide level, there are 52 (13%) Endangered (EN) and 77 (20%) Vulnerable (VU) habitat types, and all habitat type groups apart from seminatural grasslands and wooded pastures are represented fairly evenly among them. The only habitat type assessed as Collapsed (CO) in the previous assessment – alder meadows – was not an assessment unit this time because the classification of seminatural grasslands had been amended by incorporating coppice and alder meadows into pollard meadows. In this assessment, alder meadows are regarded as a previously CO-listed subtype of pollard meadows.

There are 71 (18%) Near Threatened (NT) and 91 (23%) Least Concern (LC) habitat types in the whole country. This means that, among all of the Red List categories, LC is the largest category, and habitat types assessed as LC are distributed fairly evenly among the various habitat type groups, with the exception of seminatural grassland and wooded pasture and forest habitat types. Environments where human impacts are low due to a remote location or difficult-to-access terrain have been assessed as LC. Examples of these include some fell area habitat types, acidic rock outcrops and scree as well as the most oligotrophic mire habitat types whose occurrence focuses on Northern Finland. The LC category also includes habitat types whose area has increased over the past decades and for which no significant quality decline has been observed (e.g. coastal reedbeds with *Phragmites australis* and coastal *Salix* thickets). Among Baltic Sea habitat types, those assessed as LC include benthic habitat types whose species tolerate or even benefit from eutrophication.

A total of 40 habitat types (10%) were assessed as Data Deficient (DD) in the whole country. These are mainly habitat types included in the assessment as new ones, such as new Baltic Sea and inland water and shore habitat types.

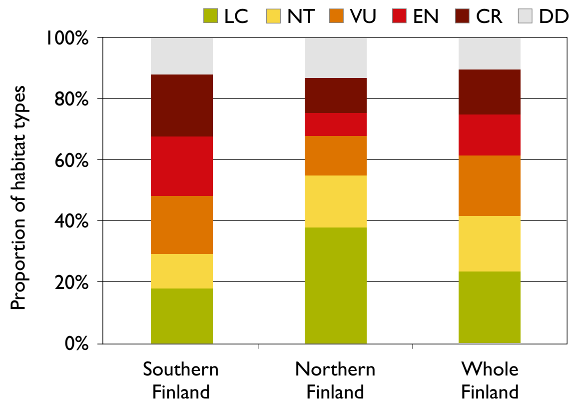

Figure 5.3. Breakdown of habitat types into IUCN Red List categories by percentage of number of habitat types in Southern Finland (317 types), Northern Finland (253 types) and the whole of Finland (388 types) (percentages were calculated from the lowest hierarchical level only, i.e. group-level assessments are not included.

Threatened habitat types account for the highest percentage of habitat types in terms of number at the nationwide level among seminatural grasslands and wooded pastures (100%) and forest habitat types (76%) and for the lowest percentage among inland water (20%), Baltic Sea (24%) as well as rock outcrop and scree (25%) habitat types (Figure 5.4a, Table 5.2). Among inland water and Baltic Sea habitat types, the rather low percentages of threatened habitat types are partly explained by the higher percentage of Data Deficient (DD) types compared with other habitat type groups. Some of these habitat types are also likely to be threatened but, in the absence of sufficient data, their Red List category could not be determined.

The percentage of Critically Endangered (CR) habitat types is clearly highest among seminatural grasslands and wooded pastures (95%) (Figure 5.4a, Table 5.2). The highest percentage of Endangered (EN) and Vulnerable (VU) habitat types can be found in the Baltic Sea coast, mire and forest habitat type groups. The percentages of Near Threatened (NT) habitat types in turn are the highest in the inland water and shore, forest, rock outcrop and scree, and fell habitat type groups.

In general, the percentage of threatened habitat types is higher in Southern Finland (59%) than in Northern Finland (32%) (Figure 5.3, Table 5.2). The difference is along the same lines in all of the assessed habitat type groups in Southern as well as Northern Finland. The biggest differences in assessment results can be seen in the mire and inland water habitat type groups (Figure 5.4b–c, Table 5.2). This is affected especially by differences in land use intensity: in Northern Finland, the rate of ditch drainage of mires and mineral soils has been lower, the share of cultivated land and constructed areas is smaller, the nutrient loading of water bodies has been lower and the share of areas protected in various ways is considerably higher than in Southern Finland.

The results of the threat status assessment are presented above as percentages of the number of habitat

Table 5.2. Breakdown of habitat types into IUCN Red List categories within different habitat type groups and regions: the whole of Finland, Southern Finland and Northern Finland (only the lowest level of classification).

	Baltic Sea		Baltic Sea coast		Inland waters and shores		Mires		Forests		Rock outcrops and scree		Seminatural grasslands and wooded pastures		Fell habitats		All habitats	
	types	%	types	%	types	%	types	%	types	%	types	%	types	%	types	%	types	%
Whole Finland																		
LC, Least Concern	14	33.3	12	26.7	13	22.0	13	18.8	0	0.0	19	43.2	0	0.0	20	37.7	91	23.5
NT, Near Threatened	4	9.5	7	15.6	15	25.4	13	18.8	7	20.6	12	27.3	0	0.0	13	24.5	71	18.3
VU, Vulnerable	5	11.9	12	26.7	5	8.5	20	29.0	17	50.0	9	20.5	0	0.0	9	17.0	77	19.8
EN, Endangered	5	11.9	12	26.7	4	6.8	14	20.3	9	26.5	2	4.5	2	4.8	4	7.5	52	13.4
CR, Critically Endangered	0	0.0	2	4.4	3	5.1	5	7.2	0	0.0	0	0.0	40	95.2	7	13.2	57	14.7
CO, Collapsed	0	0.0	0	0.0	0	0,0	0	0,0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
DD, Data Deficient	14	33.3	0	0.0	19	32.2	4	5.8	1	2.9	2	4.5	0	0.0	0	0.0	40	10.3
Total	42	100.0	45	100.0	59	100.0	69	100.0	34	100.0	44	100.0	42	100.0	53	100.0	388	100.0
Threatened	10	23.8	26	57.8	12	20.3	39	56.5	26	76.5	11	25.0	42	100.0	20	37.7	186	47.9
Southern Finland																		
LC, Least Concern	14	33.3	12	26.7	9	17.3	4	6.8	0	0.0	18	41.9	0	0.0	-	-	57	18.0
NT, Near Threatened	4	9.5	7	15.6	7	13.5	1	1.7	6	17.6	11	25.6	0	0.0	-	-	36	11.4
VU, Vulnerable	5	11.9	12	26.7	6	11.5	17	28.8	15	44.1	5	11.6	0	0.0	-	-	60	18.9
EN, Endangered	5	11.9	12	26.7	9	17.3	18	30.5	9	26.5	7	16.3	2	4.8	-	-	62	19.6
CR, Critically Endangered	0	0.0	2	4.4	3	5.8	16	27.1	3	8.8	0	0.0	40	95.2	-	-	64	20.2
CO, Collapsed	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	-	-	0	0.0
DD, Data Deficient	14	33.3	0	0.0	18	34.6	3	5.1	1	2.9	2	4.7	0	0.0	-	-	38	12.0
Total	42	100.0	45	100.0	52	100.0	59	100.0	34	100.0	43	100.0	42	100.0	-	-	317	100.0
Threatened	10	23.8	26	57.8	18	34.6	51	86.4	27	79.4	12	27.9	42	100.0	-	-	186	58.7
Northern Finland																		
LC, Least Concern	-	-	-	-	25	45.5	27	49.1	2	8.0	22	56.4	0	0.0	20	37.7	96	37.9
NT, Near Threatened	-	-	-	-	6	10.9	11	20.0	8	32.0	5	12.8	0	0.0	13	24.5	43	17.0
VU, Vulnerable	-	-	-	-	4	7.3	9	16.4	7	28.0	4	10.3	0	0.0	9	17.0	33	13.0
EN, Endangered	-	-	-	-	0	0.0	4	7.3	7	28.0	4	10.3	0	0.0	4	7.5	19	7.5
CR, Critically Endangered	-	-	-	-	1	1.8	0	0.0	0	0.0	0	0.0	21	80.8	7	13.2	29	11.5
CO, Collapsed	-	-	-	-	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
DD, Data Deficient	-	-	-	-	19	34.5	4	7.3	1	4.0	4	10.3	5	19.2	0	0.0	33	13.0
Total	-	-	-	-	55	100.0	55	100.0	25	100.0	39	100.0	26	100.0	53	100.0	253	100.0
Threatened	-	-	-	-	5	9.1	13	23.6	14	56.0	8	20.5	21	80.8	20	37.7	81	32.0

types. The areas covered by habitat types can, however, vary considerably from rare and small habitat types such as snowbeds or calcareous rock outcrops to widespread and common habitat types, which include many heath forest ones. Data is therefore also required on the area covered by threatened habitat types to supplement the overall picture of the threat status of habitat types. It is not, however, possible to provide precise figures on the areas of threatened habitat types due to the absence of comprehensive and reliable area data on many habitat types. The known, rather rough estimates of area can be used to estimate indicative habitat type area proportions for just under 70% of Finland's area, which is around 338,450 km^2 including inland waters but no marine areas. The calculation includes lakes, ponds, undrained mires, heath forests, rock outcrops and scree, seminatural grasslands and wooded pastures, and fell habitat types. Around 50% of the total area of these habitat type groups belongs to habitat types that are classified at the nationwide level as threatened (CR, EN, VU), just over 40% to Near Threatened (NT) ones and around 6–7% to Least Concern (LC) ones. Many Data Deficient (DD) habitat types also lack estimates of area, so the percentage of their area could not be assessed here.

The percentage of the area of threatened habitat types is in the same range as their proportion in terms of their number, but the area percentages of NT and LC habitat types differ quite clearly from their percentages calculated on the basis of their number. In the whole country, NT habitat types account for 18% of the number of habitat types but for more than 40% of their estimated area. LC habitat types account for 24% of the total number of habitat types but for only 6–7% of their area. The difference is explained by the fact that many particularly large-sized habitat types have been assessed as NT. Examples of these include many lake types, oligotrophic pine mire and bog types and, for example, the most extensive individual forest habitat type – mature conifer-dominated mesic heath forests.

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

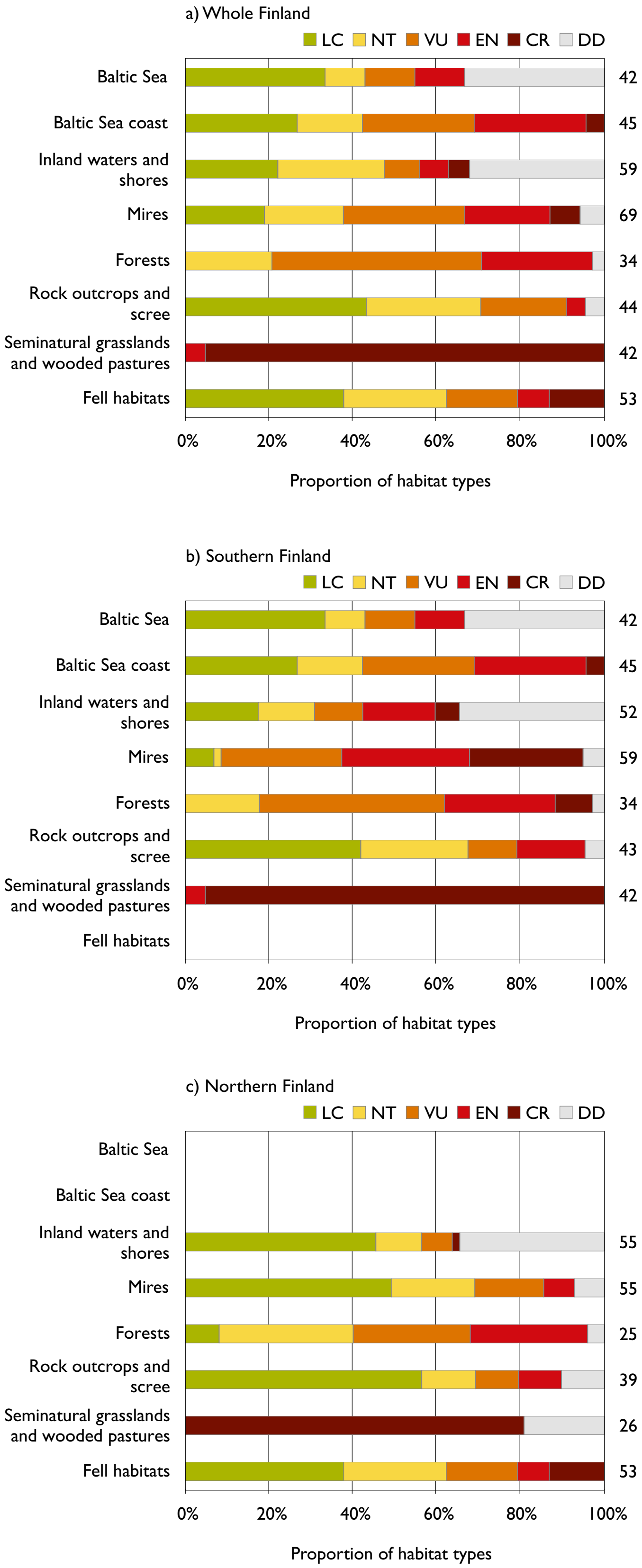

Figure 5.4. Breakdown of habitat types into IUCN Red List Categories in the whole of Finland, Southern Finland and Northern Finland by main group of habitats (percentages of numbers of habitat types at the lowest level of hierarchy). Figures on the right show the numbers of assessed habitat types for each of the main groups in the given region.

The examined lake and pond habitat types cover around 85% of the surface area of Finland's inland waters. In the whole country, just under 2% of their area was classified as threatened, around 85% as Near Threatened (NT) and around 13% as Least Concern (LC). In streams and rivers, the percentage of the area of threatened habitat types is known to be considerably larger even though the proportions of the different stream and river types have not been studied. All streams and rivers in the boreal zone are threatened with the exception of 1 Near Threatened (NT) and 4 Data Deficient (DD) types. As many as 3 of the threatened types are classified as Critically Endangered (CR).

Baltic Sea underwater habitat types cover more than 10% of Finland's total area, but no corresponding estimates can be provided on the percentages of their respective areas.

Forests and mires account for most of the area of Finland's terrestrial habitat types. The area of heath forests included in the threat status assessment totals almost 150,000 km^2 and that of undrained mires around 40,000 km^2. In the nationwide results, two thirds of the area of heath forests is classified as threatened and one third as Near Threatened (NT). Of the area of undrained mires, around 35–40% belongs to threatened, around 40% to Near Threatened (NT) and around 20% to Least Concern (LC) habitat types.

Around 10% of Finland's current area comprises densely built areas, cultivated land or other intensively human-altered environments (Corine Land Cover 2012) and around 14% drained peatlands (Korhonen et al. 2017). As the threat status assessment includes all environments, except for those intensively altered by humans, it can be roughly assumed that the total combined current area of the assessed habitat types represents 76% or 90% of Finland's area (excluding marine areas) depending on whether or not drained peatlands are included. Drained peatlands have a dual status in the threat status assessment. They are regarded as constituting loss of original area of mires in the habitat type-level assessment of mires, and the threat status of ditched mires, altered mire communities and drained peatland forests was not assessed separately in the project. Instead, in the quality criterion-based habitat complex assessment, drained mires were included in the examined entity in a manner whereby drained areas impair the quality of the habitat complex.

Intensively human-altered environments represent to a rather large extent the loss of habitat types having taken place over the past 50 years. Over the same time frame, however, habitat type occurrences have also transformed into other habitat types which are included in the assessment. For example, some mountain birch forests have been transformed due to autumnal moth (*Epirrita autumnata*) damage into secondary mountain heaths and some open seashores have turned into reedbeds or scrubs due to overgrowth.

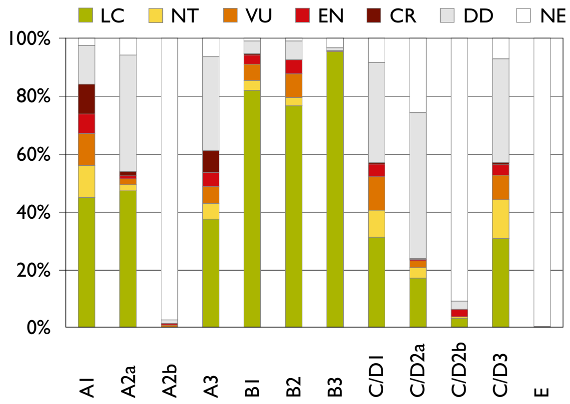

Figure 5.5. Habitat type assessment criteria and percentages of IUCN Red List categories assigned on the basis of them for the whole of Finland. The bars also show the percentages of habitat types Not Evaluated (NE) using the criterion in question. The figure only includes assessment units at the lowest hierarchical level of the classification (388 habitat types or habitat complexes). The criteria are as follows: A = quantitative reduction, A1: the past 50 years, A2a: the next 50 years, A2b: a 50-year period including the past, present and future, A3: historical time frame since 1750; B = restricted distribution combined with continuing decline, B1: restricted extent of occurrence, B2: restricted area of occupancy, B3: very small number of locations; C/D = qualitative decline (abiotic environment and/or biotic processes), C/D1: the past 50 years, C/D2a: the next 50 years, C/D2b: a 50-year period including the past, present and future, C/D3: historical time frame since 1750; E = quantitative analysis of probability of ecosystem collapse.

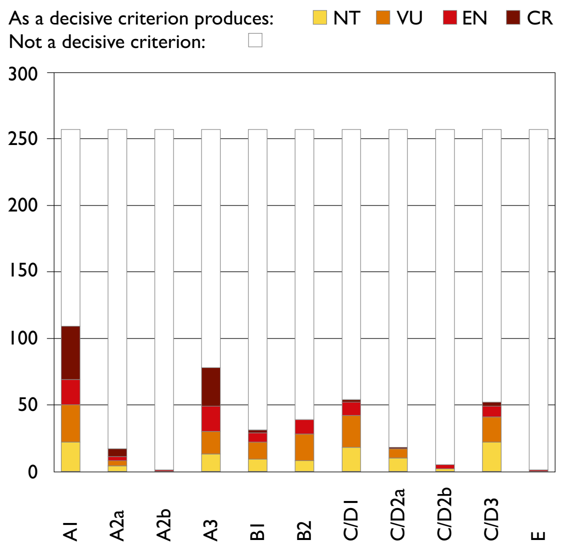

Figure 5.6. Decisive criteria determining the overall threat status for threatened and Near Threatened (NT) habitat types. The y-axis shows the total number of threatened and NT habitat types (257 habitat types) and the coloured sections of the bars indicate the number of habitat types for which the criterion in question alone or together with another criterion was the decisive criterion determining the overall threat status. The colours also represent the IUCN Red List categories assigned on the basis of the assessment.

5.3
Criterion-specific results and criteria decisive for the final IUCN Red List categories

In accordance with the IUCN methodology, efforts were made in the assessment of each habitat type to employ as many assessment criteria as possible. There were, however, four criteria that were used less than the others (Figure 5.5), and criterion E was only applied in the assessment of one habitat type, namely palsa bogs. Quantitative or qualitative changes were examined on the basis of a period of 50 years including the past as well as the future (criteria A2b and C/D2b) only regarding a small proportion of habitat types: lakes, streams and rivers, and certain seminatural grassland and wooded pasture as well as fell habitat types. Criteria based on qualitative changes projected for the coming 50 years (criteria C/D2a) were also used less often than other criteria.

With many criteria, threat status assessments resulted quite often in classification as Data Deficient (DD) (Figure 5.5). The share of this category was at its smallest in assessments based on criterion B as the current geographic distribution of a habitat type is usually known better than its quantitative or qualitative changes. Likewise, quantitative changes over the past 50 years could also be assessed reasonably well, and the proportion of habitat types classified as DD was small among assessments based on criterion A1. As regards the other criteria, DD accounted for 30–70% of the assessments that could be conducted at all using the criterion in question.

Of those habitat type for which a quantitative or qualitative change that had already taken place could be determined (excluding categories NE and DD), around 40–50% fall, on the basis of that change, under a Near Threatened (NT) or threatened category based on criteria A1, A3, C/D1 and C/D3 (Figure 5.5). In other words, a considerable proportion of habitat types has undergone a significant quantitative or qualitative decline either over the past 50 years or over the historical time frame.

On the basis of criterion B, the majority of habitat types are classified as Least Concern (LC) because habitat types below the thresholds for criterion B that are considerably rare and declining only account for a small proportion of the assessed habitat types. Examples of these include drift lines with *Zostera marina*, fixed coastal dunes with *Empetrum nigrum* (brown dunes), southern fen complexes, herb-rich forests with European white elm, calcareous open flat rock outcrops, herb-rich heaths, wooded pastures dominated by hardwood deciduous trees, *Empetrum* mountain birch forests, and many snowbed types. Some habitat types which are small in area fall below the thresholds for criterion B but, as no decline or threat of decline has been observed regarding them, they are classified as LC. Examples of these include mountain serpentine rock outcrops and boulder fields, and fen-rich mountain meadows.

The overall threat status of a habitat type is determined on the basis of one or more criteria providing the highest

IUCN Red List category. In the nationwide assessment, there are a total of 257 threatened and Near Threatened (NT) habitat types. Figure 5.6 shows how often a specific criterion alone or together with other criteria is decisive in determining the final Red List category of a habitat type. Subcriterion A1 – quantitative decline over the past 50 years – was the decisive criterion most frequently, for a total of 109 habitat types. Subcriterion A3 – quantitative decline since 1750 – was the decisive criterion for 78 habitat types and subcriteria C/D1 and C/D3 – qualitative decline over the past 50 years or since 1750 – for more than 50 habitat types. Subcriteria B1 and B2 – restricted geographic distribution combined with decline or a small number of occurrences – were decisive in the category assignment of 30–40 habitat types, whereas criteria assessing future development (A2, C/D2 and E) were decisive in fewer cases.

The determination of the Red List category can also be examined on the basis of how often a specific criterion has determined the final category on its own. This shows whether habitat types have changed mainly with respect to their quantity or quality or whether they have become threatened mainly because they are rare. Altogether 45% of the habitat types assessed as threatened or Near Threatened (NT) in the whole country have become threatened mainly due to changes in quantity. Baltic Sea and mire habitat types as well as seminatural grasslands and wooded pastures were assessed as having, in most cases, undergone quantitative changes but, for Baltic Sea habitat types in particular, this result is explained also by poor knowledge of qualitative changes.

Around 30% of the overall threat status classifications were in turn determined mainly on the basis of qualitative changes, that is criteria C, D or CD. Qualitative changes were assessed as the most significant factor for habitat types becoming threatened among inland water and forest habitat types in particular. In around 9% of the assessments, the rarity-related criterion B alone determined the final Red List category. The significance of criterion B was high for rock outcrop habitat types, especially for rare calcareous and serpentine rock outcrops. In around 17% of the assessments, the final category assignment resulted from multiple criteria yielding the same result.

The decisiveness of the time frames examined for the assessment is also an interesting point. Changes over the past 50 years determined, on their own, the Red List category of 24% of the habitat types spread fairly evenly across the habitat type groups (Appendix 2). Changes over the historical time frame in turn were decisive for 23% of the habitat types. The majority of these are inland waters, mires and heath forests. Predictions of changes taking place in the future determined, on their own, the Red List category of only 4% of the habitat types, most of which are fell habitat types threatened by climate change. In other cases, the underlying reasons for habitat types becoming threatened comprised equally significant changes over multiple time periods or combined with the rarity of the habitat type (criterion B).

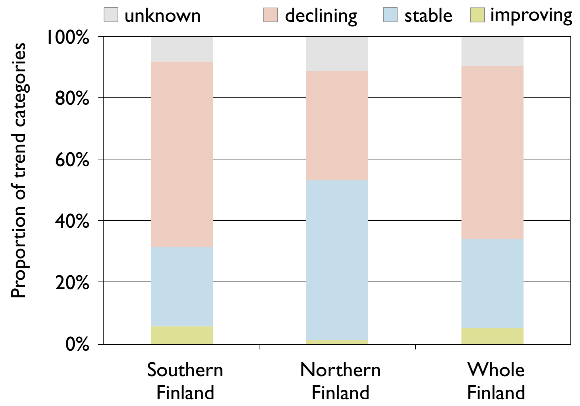

Figure 5.7. Breakdown of habitat types into trend categories in Southern Finland (317 habitat types and habitat complexes), in Northern Finland (253) and in the whole country (388). The figure includes assessed habitat types and habitat complexes at the lowest hierarchical level of the classification.

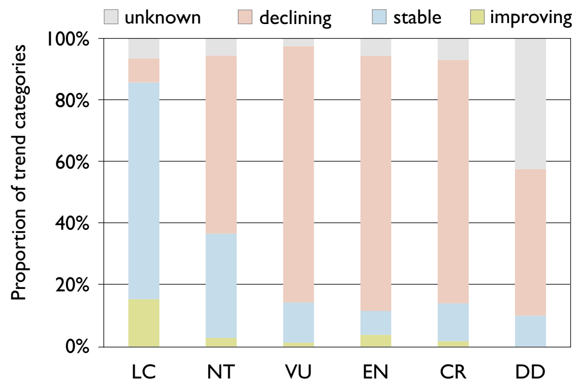

Figure 5.8. Breakdown of habitat types classified under the various IUCN Red List categories into categories in accordance with their trends in the whole country.

5.4
Trends

Habitat types were also assessed concerning the current and near-future trends of their state. Trends are not included in the IUCN assessment methodology. Instead, this is additional data assessed for national needs.

The trend for 57% of habitat types in the whole country and for 62% in Southern Finland was regarded as declining, whereas the trend for more than half (51%) of the habitat types in Northern Finland was regarded as stable (Figure 5.7). In the whole country, only 5% of the habitat types were assessed as undergoing an improving trend. The trend for around 9% of the habitat types could not be assessed.

In principle, the trend for a habitat type is not dependent on its IUCN Red List category. However, the trend was regarded as declining more often for threatened or Near Threatened (NT) habitat types than for Least Concern (LC) types (Figure 5.8) because in most cases the developments leading to the habitat type

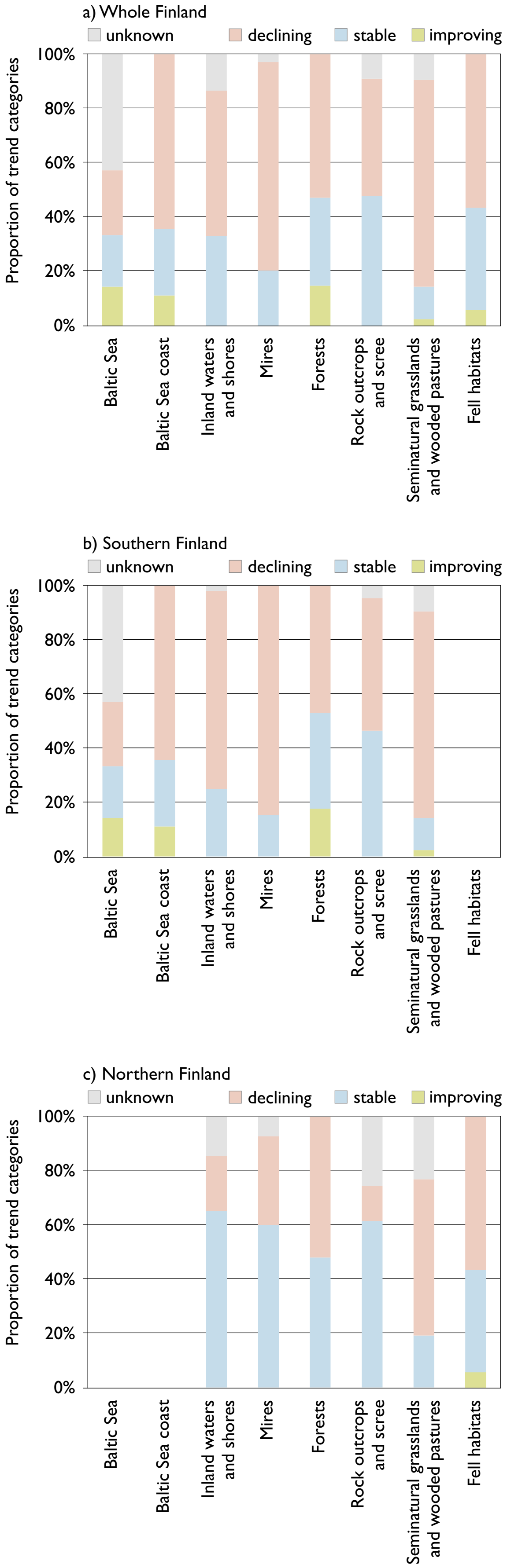

Figure 5.9. Breakdown of habitat types into trend categories on the basis of number of habitat types in the various habitat type groups.

becoming threatened are projected to continue in the near future, too. In contrast, the trend for LC habitat types is in most cases regarded as stable.

Figure 5.9 shows the percentages of the trends by habitat type group. Generally speaking, the magnitude of the percentages of habitat types whose trend is assessed as declining is about the same as that of the percentages of habitat types assessed as threatened or threatened and Near Threatened (NT). An exception to this are forests, where the trends of the habitat types provide a slightly more positive picture than their Red List categories. In many cases, forest habitat types are threatened due to a decline that took place a long time ago and that has since been interpreted as having halted and, in some cases, even having been reversed into a status improvement.

Habitat types whose trend is assessed as improving include such Baltic Sea and coastal habitat types that benefit rather than suffer from eutrophication, such as benthic habitats characterised by watermilfoil (*Myriophyllum spicatum* and/or *Myriophyllum sibiricum*), benthic habitats characterised by unattached rigid hornwort (*Ceratophyllum demersum*), and coastal reedbeds with *Phragmites australis*. Threatened seminatural grasslands also include one seashore meadow type – low graminoid seashore meadows, whose trend was regarded as improving thanks to more extensive and efficient management. Also counted as those with an improving trend were some heath forest habitat types whose quality is assessed as improving as a result of an increased volume of deadwood and number of large trees, and habitat types including mountain forests with aspen, pine or spruce, which are deemed to benefit from global warming.

5.5
Reasons for becoming threatened and threat factors of habitat types

The reasons for a habitat type becoming threatened mean past or present reasons that have resulted in the current state of the habitat type. Reasons for habitat types becoming threatened have been recorded for threatened, Near Threatened (NT) and, where possible, also Data Deficient (DD) habitat types. Threats, in turn, are factors assessed as having an impact in the future, and these may have also been recorded for habitat types currently assessed as Least Concern (LC). The number of reasons and threats varies by habitat type. Some habitat types only have an individual significant reason or threat, whereas for most types the range of reasons and threats is broad and diverse.

Assessed as the most important reasons for habitat types becoming threatened were (non-specified) forestry (F), ditch drainage (DR), clearing for agriculture (AGCL), construction (CST) and eutrophication and non-toxic pollution of water (WEP) (Figure 5.10a). If the more specifically determined forestry-related reasons – reduction in natural large-scale disturbances and other initial stages of natural succession (FDS), coarse woody

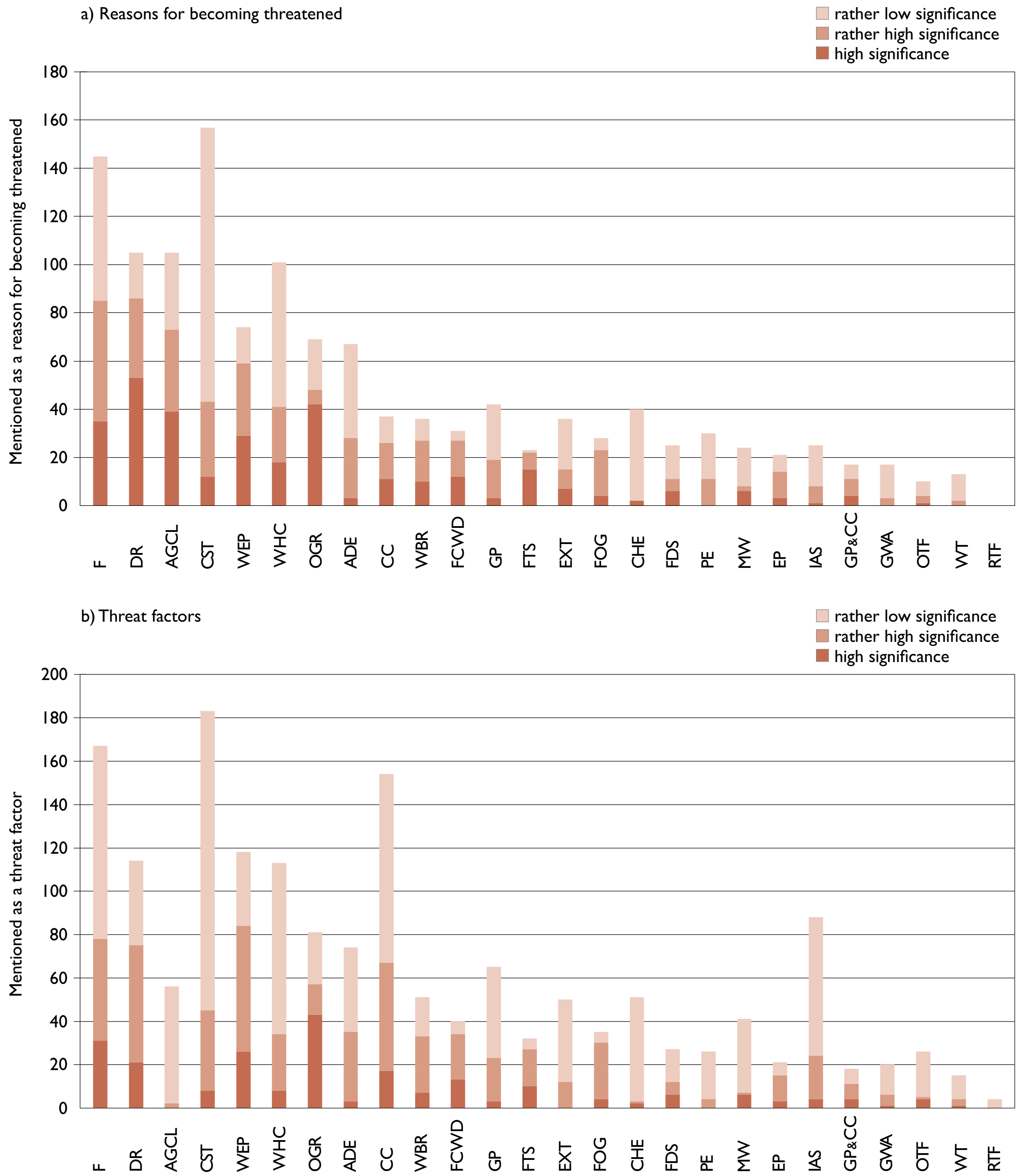

Figure 5.10. Reasons for becoming threatened (a) and threat factors (b) of all assessed habitat types. The reasons are given in the order of their overall significance. To facilitate comparisons, the threat factors are given in the same order as the reasons. The determination of the order of the reasons and the abbreviations of the threat factors are explained in section 2.6. The figures on the y-axis show the numbers of habitat types. When counted together, forestry-related factors (F, FDS, FCWD, FTS and FOG) are among the reasons for 157 habitat types becoming threatened and among the threats faced by 178 habitat types. The code GP & CC means the combined effect of intensive grazing pressure and climate change used for fell habitat types.

debris (deadwood) (FCWD) and old-growth forests and individual old trees (FOG) and changes in tree species composition (FTS) – are combined with the F code, this more broadly interpreted factor is more clearly the most important reason for Finnish habitat types becoming threatened.

Forestry (F) was assessed as being among the three most important reasons for coastal habitat types, mires, rock outcrops as well as seminatural grasslands and wooded pastures. Among coastal habitat types, this applies to wooded types such as primary succession forests on the land uplift coast. In many mire habitat types, forest operations affect not only trees but also the hydrology of the mire. Rock outcrops and scree are usually surrounded by forests and therefore, on the one hand, are susceptible to changes in microclimate and light exposure caused by felling but, on the other hand, also to accelerating overgrowth taking place at the edges of dense-planted sapling stands. In seminatural grasslands and wooded pastures, active afforestation of meadows and dry meadows as well as felling and other forestry operations carried out in wooded pastures and grazed woodlands have been significant reasons for these habitat types becoming threatened.

The assessment of forest habitat types involved a more detailed breakdown of forestry-related reasons for habitat types becoming threatened. The most significant reasons identified were a reduction in coarse woody debris (deadwood) (FCWD), reduction in old-growth forests and individual old trees (FOG) as well as changes in tree species composition (FTS).

The significance of **ditch drainage** (DR) as a reason for habitat types becoming threatened is highest for mires, but small water bodies and many other habitats on moist and mesic sites, such as moist and mesic herb-rich forests, have also suffered from drainage. The drainage of mires and mineral soils alike reduce water quality in downstream water bodies.

Clearing for agriculture (AGCL) is an important reason for eutrophic mire and herb-rich forest habitat types as well as seminatural grasslands and wooded pastures in particular becoming threatened. The clearing of, for example, rich fens, eutrophic spruce mires and herb-rich forests for agriculture already began hundreds of years ago, and seminatural grasslands and wooded pastures have continued to be turned into crop fields in recent decades, too. In this threat status assessment as well as in the previous one, clearing for agriculture is, in the comparison of reasons and threats (Figure 5.10), the most clearly altered factor. The threat it poses is no longer deemed to be as high in the future.

Construction (CST) was assessed as a reason of high significance only for a small proportion of habitat types, but it is the fourth-most important in terms of overall significance. Construction is mentioned frequently as a reason for habitat types such as mire, shore and rock outcrop types as well as seminatural grasslands and wooded pastures becoming threatened. Road and shoreline construction are usually its most significant forms. Construction causes not only the direct destruction of habitat types but also fragmentation of occurrences, which may impair habitat type quality.

The significance of **eutrophication and non-toxic pollution of water** (WEP) is highest as a reason for Baltic Sea underwater habitat types and many lake and pond types becoming threatened. The adverse effects of eutrophication, such as accelerating overgrowth, can be seen clearly in coastal habitat types closest to the waterfront, too. Various forms of **hydraulic construction** (WHC) (dredging, port and fairway construction, damming, channel straightening, lake draining) are reasons for several Baltic Sea and inland water habitat types as well as habitat types located on shores becoming threatened. Hydraulic construction is closely connected to **water body regulation** (WBR), which is a significant reason for stream, river and lake habitat types, freshwater shore habitat types and flooded forests becoming threatened.

Overgrowth of open areas (OGR) caused by the discontinuation or reduction of traditional use of pastures and meadows is the most significant or one of the most significant reasons for all seminatural grasslands and wooded pastures becoming threatened. The same reason is mentioned for several shore habitat types and also for many mire types, especially rich fens, where it mainly refers to overgrowth following the discontinuation of free grazing and movement of cattle. Overgrowth of open areas is also linked to **atmospheric deposition of eutrophying substances** (ADE), which usually means nitrogen deposition. It is mentioned as a reason for many different habitat types from coastal habitat types to mires, nutrient-poor forests, and rock outcrop habitat types becoming threatened.

Climate change (CC) is mentioned clearly more often as a reason for habitat types becoming threatened than in the previous assessment. It is of the highest significance for fell habitat types, especially snowbeds and snow patches, but also for many habitat types dependent on frost heaving and others such as mountain birch forests. A further significant reason for fell habitat types becoming threatened is **intensive grazing pressure** (GP). Intensive grazing pressure causes alterations in species composition and wear of vegetation in many fell habitat types. In mountain birch forests, intensive grazing pressure may prevent forest regeneration, but grazing is regarded as having to some extent curbed dwarf shrub and scrub expansion related to climate change in open fell habitat types. In some fell habitat types, intensive grazing pressure has in part strengthened and in part counteracted impacts of climate change. These combined effects are itemised under their specific code GP & CC.

The relative significance of future threat factors (Figure 5.10b) is largely similar to that of the reasons for habitat types becoming threatened. The significance of clearing for agriculture (AGCL) is, however, clearly higher as a reason for habitat types becoming threatened than as a future threat, whereas the significance of climate change (CC) and of invasive alien species (IAS) is higher as a threat than as a reason. Climate change is mentioned as a future threat in this assessment for more than 150 habitat types, around twice the figure of the previous assessment. This change is due to both the advancement of climate change as well as to improved awareness of its impacts.

The examination of the reasons for habitat types becoming threatened and of the threat factors is based on the numbers of habitat types in Figure 5.10. If examined in terms of importance based on the areas covered by habitat types, reasons and threats relating to the threat status of extensive heath forest types, such as a reduction in initial stages of natural succession (FDS), in deadwood (FCWD) and in old-growth forests and individual old trees (FOG) and changes in tree species composition (FTS) would be ranked higher. It is not, however, possible to conduct a comprehensive examination based on area due to a lack of data.

5.6
Comparison with previous assessment

The results of the first assessment of the threat status of habitat types conducted in 2008 and those of this assessment are not directly comparable, as this assessment was conducted in compliance with IUCN methodology (IUCN 2015) instead of the national assessment method used previously (Raunio et al. 2008). The national method allowed options including assigning a lower category on the basis of a habitat type being common and widespread or assigning a higher one on the basis of rarity and small area, but the IUCN methodology does not provide for such options. However, efforts have been made to examine the IUCN Red List category changes of habitat types (Figure 5.11) and to analyse the reasons behind them.

Almost half of the habitat types (44%) were classified under the same category in 2008 and in 2018 (Figure 5.11). The highest number of unchanged classifications can be found among habitat types assessed as Least Concern (LC), but the majority of the habitat types in other Red List categories, too, were classified under the same category. The only exception is habitat types that are currently Data Deficient (DD). A total of 76 units at the lowest hierarchical level of the classification were assessed as new habitat types (column 'NE 2008' in Figure 5.11).

In the nationwide results, a vast majority (88%) of the reclassifications were due entirely or in part to a change in assessment method. Around a third of the reclassifications were caused by an increase in knowledge about the habitat type and around 11% are related to a change in habitat type classification. Multiple reasons are often specified for reclassifications, but the most common standalone reason is a change in method.

A genuine change was identified in 22 reclassifications (15%) and, with the exception of 1 case, the change led into an uplisting. Uplisting was based on a genuine negative change for habitat types including fixed coastal dunes with *Empetrum nigrum* (brown dunes), whose overgrowth was assessed as having accelerated considerably. In addition, the uplisting of, for example, thin-peated spruce mires and *Vaccinium* spruce mires as well as mountain birch forest types and snowbeds was in part attributed to a genuine change. Finnish legislation does not safeguard thin-peated spruce mires or *Vaccinium* spruce mires, where the impacts of clear cutting, soil preparation and other forestry measures were assessed as having increased especially in Southern Finland. The decline among mountain birch habitat types is to do with the combined effect of geometrid moth damage that has increased as a consequence of climate change and of continuing intensive reindeer grazing. Snowbeds, too, were uplisted in part due to accelerating climate change. In contrast, *Eriophorum vaginatum* birch fens were downlisted, which was interpreted as being partly owing to increased knowledge but also to the shift of the start of the assessment period from the 1950s to the 1960s, which reduced the percentage reduction over the 50-year time frame.

It must be underlined that it is only in cases of a genuine change that a reclassification reflects a change in the state of the habitat type. Any downlisting of habitat types from the previous assessment should not generally be interpreted as any improvement in their state and any uplistings do not generally indicate an increased risk of collapse.

IUCN method 2018 \ National method 2008	LC	NT	VU	EN	CR	DD	Multiple in 2008	NE
LC	53	12				1		25
NT	15	38	9	3		1		5
VU	2	19	30	12	2	1	5	6
EN		3	14	15	10		4	6
CR	2	5	4	7	32	4		3
DD		4	2	1		2		31

Figure 5.11. Red List categories of habitat types for the whole of Finland using IUCN methodology in 2018 and their classification based on the national method in 2008 (388 habitat types or habitat complexes). The highlighted figures show the number of classifications that remained the same in each category and the other figures indicate assessments that resulted in reclassifications. The column "Multiple in 2008"gives the number of those assessments where the habitat type classification has changed and where there were multiple habitat types assigned to different categories by the national method in 2008 corresponding to a single habitat type assessed with IUCN methodology in 2018. The habitat types given under the NE category for 2008 are new habitat types that were introduced for the first time in the 2018 assessment. The figure only includes assessment units at the lowest hierarchical level of the classification.

5.7
Climate change in the threat status assessment of habitat types

Kaisu Aapala

5.7.1
Climate change projections and changes already observed

With its various impacts on temperature, precipitation and wind conditions, climate change is a significant yet difficult-to-forecast threat factor whose habitat type-specific effects still remain uncertain or totally unknown for the majority of habitat types. In the first assessment of threatened habitat types in Finland, the impact of climate change was not taken systematically

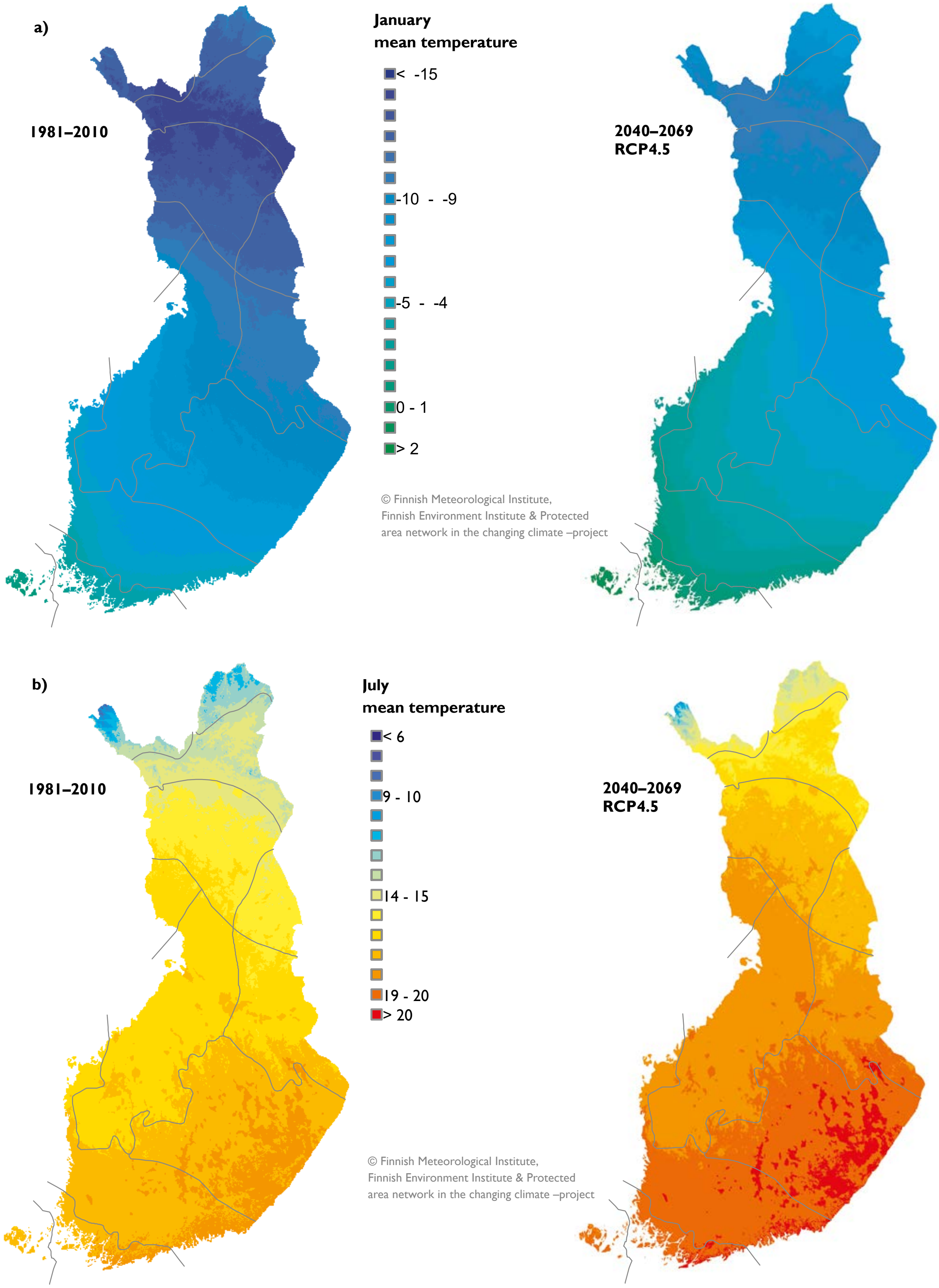

Figure 5.12. January a) and July b) mean temperatures in the 1981–2010 and 2040–2069 periods on the basis of the RCP4.5 scenario (Aalto, J., Heikkinen, R., Leikola, N., Finnish Meteorological Institute and Finnish Environment Institute, Protected area network in the changing climate project).

into account as a factor causing increased threat status. Instead, climate change affected the Red List category of only those habitat types where the impacts could already be observed or were clearly foreseeable. This assessment follows the same principle but applies it through new assessment criteria.

The Representative Concentration Pathway (RCP) scenario RCP4.5 was used as the starting point for examining aspects relating to climate change. RCP4.5 assumes that carbon dioxide emissions will grow for some time but will be reversed around 2040 and that the rise in CO2 concentration will halt at a level close to 540 ppm. According to the scenario, the mean annual temperature rise in Finland would be 1.8 °C in the 2020–2049 period relative to 1981–2010 (Ruosteenoja et al. 2016a). The rise in temperature would be the most pronounced during winters, with the projected mean temperature rise for December–February being 2.3 °C. Figure 5.12 illustrates the January and July mean temperature rise in the 1981–2010 and 2040–2069 periods based on the RCP4.5 scenario.

According to the same scenario, precipitation would increase by around 5% between the above-mentioned periods, with the highest increase to be seen in winter and spring months. Overall, the Finnish climate is projected to change more in the winter than in the summer. According to projections, wintertime precipitation will be more frequently in the form of rain, the period of snow cover will be shorter and there will be less ground frost than today (Jylhä et al. 2012). The Baltic Sea ice cover will be less extensive and thinner (Luomaranta et al. 2010). Climate change will lengthen the growing season and increase degree days (Ruosteenoja et al. 2016b).

Evidence of global warming is currently regarded as robust (Intergovernmental Panel on Climate Change, IPCC 2013a). Since the mid-20th century, changes have been observed throughout the global climate system: warming of the atmosphere and oceans, diminishing snow and ice cover, rising sea levels and increasing concentrations of greenhouse gases in the atmosphere (Intergovernmental Panel on Climate Change, IPCC 2013b). The average global temperature increased by 0.85 ºC from 1880 to 2012 (uncertainty interval 0.65–1.06 °C). Warming has also accelerated: each of the past three decades have been successively warmer that any preceding decade since the mid-1800s.

Climate change can also already be observed in Finland. The mean annual temperature has risen by around 0.9 °C over the past hundred years (1909–2009) (Jylhä et al. 2012) and by more than 2 °C since the start of regular temperature measurements in the mid-1800s (Tietäväinen 2010; Mikkonen et al. 2015). Warming has been strongest in the winter, but temperatures in spring months (March–May) have also risen faster than mean annual temperatures (Tietäväinen 2010; Mikkonen et al. 2015). Northern European precipitation rates have generally increased, but there is very strong natural interannual variability in the rates so the changes observed are not necessarily always caused by climate change (Intergovernmental Panel on Climate Change, IPCC 2013a).

Although the direct and indirect impacts of climate change on the natural environment are difficult to predict, certain changes that have already taken place are regarded as being very probably specifically due to climate change, mainly due to the rise in temperature. Extensive reviews have documented extended growing seasons, range shifts of species towards the poles or higher elevations, and advancements of spring events such as plant budburst or arrival of migratory birds (e.g. McCarty 2001; Parmesan and Yohe 2003; Root et al. 2003; Menzel et al. 2006; Harsch et al. 2009; Heino et al. 2009; Bellard et al. 2012; Stephens et al. 2016; Pecl et al. 2017).

Climate change impacts observed in Finnish habitats include a reduction in summertime snow cover in the fell area (Niittynen 2017), ascent of mountain birch and coniferous timberlines in the fell area (e.g. Juntunen and Neuvonen 2006; Sutinen et al. 2012) as well as an increase in the growth of willows (Salix spp.), other shrubs and dwarf shrubs in open fell habitat types (e.g. Pajunen et al. 2008; Kitti et al. 2009; Olofsson et al. 2009; Ravolainen et al. 2014; Christie et al. 2015), an increase in the water temperature of springs (Jyväsjärvi et al. 2015), thawing of palsas (Luoto and Seppälä 2003) and a northward shift in bird and butterfly ranges (Brommer 2004; Pöyry et al. 2009; Virkkala and Rajasärkkä 2011; Eskildsen et al. 2013; Kontiokari 2014; Virkkala and Lehikoinen 2014; Lehikoinen and Virkkala 2016; Leinonen et al. 2016).

According to Virkkala and Lehikoinen (2017), northern bird species have declined and their ranges have shifted northwards. For example, the median range of the Willow Ptarmigan (Lagopus lagopus) shifted 145 km and that of the Brambling (Fringilla montifringilla) 170 km northwards from 1974–1989 to 2006–2010. Pöyry et al. (2009) found a range margin shift of 60 km towards the north in butterflies from 1992–1996 to 2000–2004. The range shifts are currently clearest in the most mobile groups of organisms. In addition, the shift in the northern range margin of butterflies is linked with the species' habitat requirements and variation in their mobility (Pöyry et al. 2009). Phenological changes such as the advancement of plant budburst and flowering, bird migration and breeding as well as multivoltinism in moths have also been observed (e.g. Ahola et al. 2004; Lappalainen et al. 2008; Pöyry et al. 2011).

Although climate change has already resulted in a shift in the northern range margin of some of the most mobile species towards the north, no corresponding change is yet to be observed in the majority of species or habitat types. The ongoing process of climate change is so rapid that, for example, areas providing thermal optima for species may shift more rapidly than populations of low-mobility species. Because of the rapid rate of climate change it can therefore be expected that compositions of biotic communities and at the same time habitat types will change, as different species respond to climate change in different ways and their range shifts – if at all possible – take place at different rates.

5.7.2 Climate change in the threat status assessment

The significance of climate change as a reason for habitat types becoming threatened and as their future threat factor is now higher than in the previous assessment. This was affected not only by the advancement of climate change but also by increased awareness of its potential impacts. Examined under climate change in the assessment were phenomena including climate warming, increasing precipitation, increased prevalence of extreme weather phenomena, rising sea level, increasing atmospheric carbon dioxide levels (only when there are special grounds for impacts) and mass occurrences of herbivores relating to warming.

In the previous assessment, climate change was the primary reason for a few fell and northern mire habitat types (some snowbed types, snow patches, frost bogs and mires, and palsa mires) becoming threatened. In this assessment, climate change is mentioned as one of the reasons for 37 habitat types becoming threatened. These are mainly fell habitat types but also include individual Baltic Sea, inland water, mire as well as seminatural grassland habitat types.

Climate change was mentioned in the previous assessment as a future threat factor for more than 70 habitat types – around a fifth of the total number of habitat types examined. Now it is mentioned as a future threat for more than 150 habitat types or around 40% of the total.

Climate change is estimated to have had and to continue to have an impact especially on the quality of the habitats (criteria C, D and CD), although sufficient data to assess the severity of the qualitative change was not yet available. In general, climate change was assessed to have negative effects but, for example, mountain forests with aspen, pine and spruce may benefit from global warming (sections 4.8.2 and 4.8.5). In forest habitat types, potential positive effects may emerge as a result of increasing tree growth as the volume of large living trees and deadwood increases. The amount of deadwood, young succession stages with an abundance of coarse woody debris, and deciduous trees may also increase due to increasing natural disturbances.

When a qualitative change is strong enough, the habitat type occurrence collapses and the quantity of the habitat type changes. This may occur in cases such as when overgrowth caused by longer growing seasons and rising carbon dioxide levels increase vegetation cover in open habitat types. Climate change was assessed as having affected habitat type quantity (criterion A) or geographic distribution (criterion B) especially among fell habitat types but also among palsa bogs. The quantity of palsa bogs was assessed as having declined primarily due to climate change by 30–50% over the past 50 years and as declining further by more than 50% over the next 50 years, too. The probability of palsa bogs being lost was also assessed quantitatively (criterion E) by utilising previous modelling of palsa thawing (Fronzek et al. 2010; 2013).

Climate change may intensify existing problems such as eutrophication and overgrowth or detrimental impacts caused by other threat factors or by habitat fragmentation. These combined effects have been discussed concerning a few habitat types. For example, warming increases primary production, which may have an effect increasing internal nutrient loading and algal blooms in the Baltic Sea. The resulting reduced surface water transparency affects submerged habitat types by narrowing the substrate area suitable for photosynthesising plants.

Combined effects were assessed more thoroughly in the context of fell habitat types, examining the combined effects of climate change and reindeer grazing (section 4.8.2). The aim was to both specify the impacts of these threats separately and to take into account their combined effect and its significance in relation to both of the individual factors. Mountain birch forests is a good example of a habitat type group where the impact of the above-mentioned threats is intensified in their combined effect. On the one hand, mountain birch forests benefit from climate change thanks to the improved growing conditions but, on the other hand, increasing moth outbreaks are causing recurring damage. With its effect combined with that of the summer grazing of reindeer, moth damage has caused the decline of birch forests and even deforestation across extensive areas (Olofsson et al. 2009). The threat posed by the combined effect was regarded as being higher than that of the two individual threats separately. The threat is high especially in dry and dryish mountain birch forests, as their capacity to recover from moth damage is poorer than that of mesic or herb-rich mountain birch forests.

Invasive alien species benefitting from climate change appeared as potential future threats for Baltic Sea and inland water habitat types and herb-rich forests, among others. As the climate warms, species spreading from the south may also pose further threats to habitat types. These include the nun moth (*Lymantria monacha*), which poses a threat to coniferous trees and whose population has increased 80-fold in Finland over a 20-year moth monitoring period (Leinonen et al. 2016). A further threat to herb-rich forests with deciduous (hardwood) trees is posed by diseases occurring in their typical tree species, such as ash dieback (*Hymenoscyphus pseudoalbidus*), Dutch elm disease (*Ophiostoma ulmi*) and sudden oak death (*Phytophthora ramorum*) (Lilja et al. 2010).

Although the significance of climate change has been assessed as high for only relatively few habitat types, it is nevertheless regarded generally as a significant future threat factor. The impacts of climate change on underwater habitat types of the Baltic Sea are in part still unpredictable but, if materialised, may have effects extensively throughout the marine area (section 4.1.2). The assessed impacts are related to issues such as the inflow of saline water pulses into the Baltic Sea, rising sea level, potentially intensifying low pressures and consequently intensifying storms and coastal phenomena, changing precipitation rates, reducing the frequency and duration of ice winters, advancing growing seasons, increasing primary production and spread of invasive alien species. Some of these changes will probably also further intensify the impacts of the eutrophication of the Baltic Sea.

Increasing wintertime precipitation increases nutrient runoff to coastal waters, the impacts of which can be seen on the Baltic Sea coast as reedbed expansion, increasing eutrophying algal masses drifting to the shore, and overgrowth (Fact box 4.1). Another factor increasing shore overgrowth is the reduction of springtime ice erosion as winters become warmer. Over the long term, sea-level rise will have impacts particularly on the habitat types of the low-lying shores of the southern coast of Finland. The slowing or prevention of the land uplift impact has an effect on primary succession characteristics of habitat types of the land uplift coast. Reducing Baltic Sea salinity may result in a decline of marine species requiring higher salinity levels, such as the common eelgrass (*Zostera marina*) and bladder wrack (*Fucus vesiculosus*), which would mean a decline in drift lines formed by them, too.

Climate change was assessed as a future threat of growing significance for inland water and shore habitat types (section 4.3.2). Temperatures of inland waters have already risen and periods of ice cover shortened. Winter runoff is increasing, winter floods are becoming more common and spring floods are decreasing as a consequence of climate change. Changes in runoff affect nutrient leaching and sediment transport into water bodies. These changes have large-scale impacts on inland water habitat types, and climate change is therefore mentioned as a future threat for more than 80% of the assessed inland water and shore habitat types. The impacts are assessed to be strongest on water bodies in the fell area, on habitat types whose occurrence focuses on southwestern Finland as well as on oligotrophic and clear-water (low-humic) lakes.

As regards mire habitats, climate change is assessed as having an impact already in the next decades at least on those mire complexes and mire types where mire structure and vegetation is shaped by frost heaving (section 4.4.4). These types include frost bogs, palsa mires, northern reticulate raised bogs and the northern subtype of northern boreal aapa mires. The potential impacts of climate change on mire vegetation are discussed in more detail in Fact box 4.2.

Among forest habitat types, climate change was assessed as worsening the situation of the more oligotrophic heath forests due to eutrophication but as benefitting deciduous trees due to warming (section 4.5.1). Accordingly, climate change was regarded as a future threat to heath forest types other than those dominated by deciduous trees. Global warming favours deciduous (hardwood) trees[1] but, on the other hand, these species are threatened by the increased prevalence of diseases and pests brought by rising temperatures. The quantity of herb-rich forests was assessed as having genuinely increased due to factors including the general eutrophication trend seen in forests, which can in part be attributed to climate change. Climate change is also projected to alter forest disturbance dynamics in many ways, as it is known to have both direct and indirect impacts on many abiotic (fire, drought, wind, snow and ice) and biotic (insects and pathogens) disturbance agents whose combined effects may amplify disturbances (Seidl et al. 2017).

One of the factors underlying the overgrowth of rock outcrops is the increase in atmospheric carbon dioxide level. It is also deemed to accelerate the overgrowth of seminatural grasslands (section 4.7.5). Global warming reduces the erosion impact of ice on seashore and freshwater meadows, which increases the overgrowth of these habitat types. The warming-induced accelerating growth of vegetation and release of nutrients may also speed up the rate of overgrowth, particularly in unmanaged seminatural grasslands.

Climate change affects fell habitats in many ways: the snow-covered period is shortening, the surface layer of soil is drying and ground frost rates are declining, the birch and conifer timberlines are climbing, defoliator moth damage is increasing, dwarf shrub, scrub and forest expansion is increasing and frost damage to vegetation may become more prevalent (section 4.8.5). The significance of climate change as a reason for habitat types already having become threatened and as a future threat factor is high for fell habitat types. Climate change, or the combined effect of climate change and grazing pressure, was assessed as the most significant reason why all threatened (CR, EN, VU) fell habitat types except for one have become threatened. Fell habitats are extensively exposed to climate change as fell habitat types classified as Least Concern (LC) only cover 6% of the total area of fell habitat types.

Climate change poses a threat especially for habitat types dependent on snow and ground frost, such as snowbeds and snow patches as well as frost-influenced heaths. Rising temperatures, increasing precipitation rates and earlier melting of snow have an adverse effect on these habitat types. As the climate warms, the plant communities of snowbeds and snow patches eventually turn into mountain heaths and meadows.

Climate change is also projected to result in conifers colonising new areas and the conifer timberline climbing further north and higher up fells. The impacts of climate change on fell habitats are discussed in detail in section 4.8.5.

1 Norway maple (*Acer platanoides*), hazel (*Corylus avellana*), common ash (*Fraxinus excelsior*), common oak (*Quercus robur*), small-leaved lime (*Tilia cordata*), wych elm (*Ulmus glabra*), European white elm (*Ulmus laevis*).

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Finland's habitat types of national responsibility 6

6.1
Grounds for selection

Finland's first assessment of threatened habitat types involved the preparation of a list of Finland's habitat types of national responsibility once the criteria for their selection had first been produced. Some changes were made to the list during the second threat status assessment of Finnish habitat types. These mainly entailed additions within the Baltic Sea, coastal, inland water and shore, mire as well as rock outcrop and scree habitat type groups.

Correspondingly, the assessment of threatened species in Finland included the designation of Finland's national responsibility species within the best-known groups of organisms. The list and designation criteria of the responsibility species were compiled by the second working group of the Ministry of the Environment on the monitoring of threatened species (Rassi et al. 2001). The working group also proposed that the Ministry confirm Finland's obligation to preserve its national responsibility species and monitor their population development as well as launch international cooperation to preserve the responsibility species. The species and habitat types of national responsibility do not, however, at present have a status determined in legislation. The list of responsibility species has not been amended since the first listing.

There are no uniform international criteria for the designation of responsibility habitat types. National responsibility has been examined in contexts such as the threat status evaluation of Austrian biotope types (Essl et al. 2002) and the Swedish national forest protection strategy (Nationell strategi för formellt skydd av skog 2005). The Swedish approach is that the country has a special responsibility for those forest types a significant proportion of whose European distribution and remaining valuable core occurrences is located in Sweden. In Austria, the criteria have been defined in more detail and the responsibility biotopes have been divided into two groups: especially high responsibility and high responsibility biotopes (Essl et al. 2002).

National responsibility may be based either on Finland's importance as the core area of a habitat type's distribution or on the habitat type having decreased in quantity or declined to a greater extent elsewhere in Europe than in Finland. Such a key position in distribution is usually explained by special characteristics relating to Finland's climate, geological history or history of species dispersal.

The criteria for the selection of Finland's habitat types of national responsibility correspond to the Swedish approach in terms of their content, but more detailed definitions of the criteria have been provided. In the same way as in Austria, the responsibility habitat types have been divided into two groups:

Finland's responsibility for the preservation of the habitat type is:

- particularly high if a very significant proportion of Europe's representative occurrences is located in Finland. A proportion which can be regarded as the guideline value for a very significant proportion is more than 40% of the number or area of the habitat type's occurrences;
- high if a significant proportion of Europe's representative occurrences is located in Finland. A proportion which can be regarded as significant is 25–40% of the number or area of the habitat type's occurrences.

The examination area for the responsibility habitat types is Europe. In this context, Europe means the geographical area of Europe defined in accordance with Atlas Florae Europaeae (Jalas and Suominen 1972). The eastern and southeastern boundaries of the examination area are the Ural Mountains, the Ural River, the Caucasus Mountains, the eastern side of the Crimean Peninsula, the Bosporus Strait and the coast of Turkey. Focusing the examination exclusively on the EU area would improve the reliability of assessments, but an administrative delimitation would be artificial from the ecological perspective and, in addition, would undergo changes over time. Examination at the global scale is not possible due to a lack of data and to difficulties in determining equivalencies of habitat types. The geographical boundaries used for the habitat types are the same as those used for Finland's responsibility species.

In the definition of Finland's habitat types of national responsibility, the percentage for 'high responsibility' (25–40% of the number or area of occurrences) was motivated by the fact that Finland accounts for around 30% of the boreal section of the natural geographic area of Fennoscandia. Fennoscandia (the Scandinavian Peninsula, Finland, Karelia and the Kola Peninsula) is an entity with distinct boundaries and separated from the rest of Europe by its extremely old bedrock, variable relief, quaternary glaciation and related land uplift, as well as the multiple developmental stages of the Baltic Sea and the exceptionally mild and marine climate relative to its northern location (Kalliola 1973).

The idea behind this is that Finland has a high responsibility for habitat types which are only found in but occur evenly across Fennoscandia (as common or rare habitat types). The preservation of such habitat types is affected by human activities mainly in the territories of three states: Finland, Sweden and the westernmost parts of Russia. The distribution of a responsibility habitat type does not, however, have to be limited exclusively to Fennoscandia. Instead, the habitat type can, for example, be found throughout Europe's mountainous regions, but the 30% criterion can in these cases, too, be interpreted to mean a high responsibility for Finland. Finland has a particularly high responsibility for a habitat type if a very significant percentage or even the majority of the European occurrences are located in Finland.

6.2

Finland's responsibility habitat types

The list of Finland's responsibility habitat types and brief justifications for their designation are provided in Table 6.1. A total of 44 responsibility habitat types have been designated, of which 15 are habitat types of a particularly high responsibility and 29 are habitat types of a high responsibility.

Responsibility habitat types can be found in all of the main groups of habitat types and there is a focus in them especially on mire, inland water and shore as well as Baltic Sea and coastal habitat types. This is justified as Finland is one of the most mire-rich countries in the world, with mires having accounted for a third of the country's land area before ditch drainage (Solantie 2006). The quantity of inland waters is also substantial: according to the Finnish Environment Institute, Finland has 187,888 lakes that exceed 5 acres in surface area (Kuusisto 2008). The post-glacial land uplift, which shapes coastal habitats of the Baltic Sea, in turn is unique in Finland in terms of its rate (up to 9 mm per year) and scope. Primary succession takes place on the land uplift coast as vegetation appears on land exposed from the sea and is transformed further when the site becomes more and more distant from the coastline as the land uplift process continues (e.g. Vartiainen 1980; Rinkineva and Bader 1998; Rehell 2006). This creates unique forest, mire and small water body succession series that have been designated as Finland's responsibility habitat types.

Responsibility habitat types are not always the same classification units as the habitat types that underwent the threat status assessments. Instead, they are often larger entities that contain several assessed habitat types. The purpose of this is to emphasise the functional entities formed by the responsibility habitat types and their underlying phenomena, which lay the foundation for the abundance, uniqueness or representativeness of these habitat types in Finland. On the other hand, there are a few responsibility habitat types which are narrower than the habitat types of the threat status assessment. For example, the responsibility habitat type of seashore meadows of the land uplift coast does not include the entire seashore meadow habitat type group assessed but, instead, only comprises meadows located on the land uplift coast.

Consequently, Finland's responsibility for certain habitat types is based on natural features and phenomena typical of our country. Underlying reasons for the designation of the underwater Baltic Sea habitat types of responsibility included the Baltic Sea's low salinity, shallowness, long ice-covered period and abundance of hard rocky bottoms. In addition, the Baltic Sea coast responsibility habitat types have been affected by post-glacial land uplift, sorting and accumulation of sediments by meltwater from the continental glacier, as well the absence of tides.

The characteristics of responsibility habitat types of inland waters are related, for example, to topography sculpted by the Ice Age and to a climate favouring paludification, which have created lake routes (chains of lakes) typical of Finland as well as lakes and ponds which are characterised by input of humic water from mires. Inland water responsibility habitat types are also found in esker areas formed by the Ice Age whose soil is sorted and which act as groundwater recharge areas.

Among mires, flark-level aapa mires and their characteristic flark fens and rich flark fens are typical of Finland and related to Finland's flat relief and low rate of rainwater evaporation. Finland's responsibility habitat types also include mires typical of the sporadic permafrost zone (permafrost occurring in patches outside its primary range), such as palsa mires and frost bogs and mires. Corresponding types are found only in northern parts of Norway, Sweden and Russia. In more southern parts of Finland, concentric raised bogs are mires of a particularly high responsibility, as their occurrence zone is clearly broader than in Sweden.

Factors underlying the designation of forest responsibility habitat types include Finland's acidic bedrock and soil as well as the impacts of the Ice Age on the abundance of rock outcrops and the formation of eskers. In Finland's northern Scots pine (*Pinus sylvestris*) forests, the Scots pine grows further up north than the Norway spruce (*Picea abies*), which is exceptional in the north boreal zone. The forest responsibility habitat types were not examined in conjunction with this threat status assessment. Instead, they are presented in accordance with the previous assessment (Tonteri et al. 2008).

The rocky habitats of national responsibility are related to Finland's acidic bedrock sculpted by the continental glacier as well as the post-glacial development stages of the Baltic Sea, which formed boulder fields of raised beaches that are currently located further away from the coastline and even deep inland. Boulder fields have also been formed by frost heaving, which is strong in Finland due to the cold climate. Rapakivi granite in turn is a relatively rare rock type that in Finland forms representative, strongly weathered outcrops composed of loose stones and gravel.

Seminatural grasslands and wooded pastures is the group with the smallest number of designated responsibility habitat types. This is because these habitat types are so declined these days that the proportion of their Finnish occurrences does not exceed the threshold given in the definition of responsibility habitat types. Therefore the responsibility habitat types do not include all of the types of seminatural grasslands and wooded pastures specified by the working group on the management of seminatural grasslands (Salminen and Kekäläinen 2000) as particularly characteristic of Finland. Seminatural grasslands and wooded pastures have declined elsewhere in Europe, too, but in Sweden, for example, there are considerably more remaining occurrences than in Finland. The only habitat type of this kind designated as Finland's responsibility habitat type is seashore meadows on the land uplift coast. It was selected because it is particularly distinctive and extensive in Finland due to land uplift, the low-lying coastal topography and other special characteristics of the Baltic Sea.

The designation of fell habitat types of responsibility was based on special climate and soil conditions such as intensive frost heaving and crown snow load formation, which lowers the timberline. A timberline formed by deciduous trees is a Fennoscandian speciality, as in areas further in the east the mountain birch zone is replaced by forest tundra formed by the Siberian spruce (*Picea obovata*) and larches (*Larix* spp.). The lichen-rich mountain birch forest type of dry and oligotrophic soils was designated as a responsibility habitat type because its occurrence focuses especially on Finland.

Whether or not a habitat type is threatened was not used as a ground for designation as a responsibility habitat type. Instead, the definition of responsibility habitat types is based solely on the proportion of representative occurrences located in Finland. Consequently, the responsibility habitat types also include habitat types that are widespread and at least mostly assessed as Least Concern, such as coastal gravel, shingle and boulder shores, islands and islets in the outer archipelago, forests on rocky terrain, and open roches moutonnées. Threatened habitat types that are virtually unfound elsewhere in Europe or that have declined elsewhere, too, in the same way or more than in Finland have, however, also been designated as responsibility habitat types. The most threatened responsibility habitat types include natural forest and mire succession series of the land uplift coast and seashore meadows on the land uplift coast.

Table 6.1. Proposal for Finland's habitat types of national responsibility and justifications for their selection. * The forest responsibility habitat types were not examined in conjunction with this threat status assessment. Instead, they are presented in accordance with the previous assessment (Tonteri et al. 2008).

Habitat types of national responsibility	Level of responsibility	Justifications	Correspondence with the assessed habitat types or habitat type complexes
BALTIC SEA			
Benthic habitats characterised by Charales	High	According to current knowledge, a significant proportion of the Baltic Sea's benthic habitats characterised by Charales is located in Finland (HELCOM Red List Biotope Expert Group 2013). In Europe's other marine areas, this habitat type features a different species composition that, for example, does not include freshwater species among the accompanying species.	Contains two habitat types: exposed benthic habitats characterised by Charales and sheltered benthic habitats characterised by Charales
Benthic habitats characterised by *Zostera marina*	High	The common eelgrass (*Zostera marina*) communities of northern Baltic Sea differ from those found in more southern parts of the Baltic Sea and in the Atlantic in that they are multi-species communities consisting of oceanic seagrass species (*Z. marina* and the widgeon grass *Ruppia maritima*) as well as of freshwater and brackish water vascular plants (e.g. the pondweeds *Zannichellia* spp., *Potamogeton* spp. and *Stuckenia pectinata*). The common eelgrass of northern Baltic Sea also differs genetically from occurrences in other areas.	Corresponds to the assessed habitat type of the same name

Rocky bottoms of the Baltic Sea	Particularly high	The Baltic Sea is a unique brackish water basin whose special characteristics include shallow rocky bottoms shaped by the Ice Age and their respective biotas. These habitat types are focused on the Finnish coast and the Baltic Sea coast of Sweden.	Contains the following assessed habitat types: benthic habitats characterised by *Fucus*, benthic habitats characterised by red algae, benthic habitats characterised by perennial filamentous algae, benthic habitats characterised by *Mytilus*, and reefs
Benthic habitats characterised by aquatic moss	Particularly high	Benthic habitats characterised by aquatic moss are a speciality of stony bottoms limited to the northernmost parts of the Baltic Sea and not found in the more southern parts of the Baltic Sea or on the Atlantic side.	Corresponds to the assessed habitat type of the same name
Pelagic habitats of northern Baltic Sea	Particularly high	The Baltic Sea is a unique brackish water basin whose northern pelagic habitats form an entity that differs from the more southern marine areas due to its characteristics related to aspects including salinity, seasonality and biotic communities. No corresponding pelagic habitats, including biota, can be found in inland waters, either.	Contains the following assessed habitat types: pelagic habitats in the northern Baltic Proper and the Gulf of Finland, pelagic habitats in the Bothnian Sea and the Åland Sea and pelagic habitats in the Bothnian Bay
Sea ice	High	Finland is the only country in Europe and at the same time in the world whose entire coastline (still) freezes over every winter. The salinity of the water mass surrounding sea ice in Finland is low, which affects the composition of the biotic community living on the surfaces of and inside sea ice.	Corresponds to the assessed habitat type of the same name
Succession series of fladas and glo-lakes (coastal lagoons) on the land uplift coast	Particularly high	Land uplift does not take place to this extent anywhere else in Europe apart from Sweden and the White Sea. The topography of Finland's coast is less steep than Sweden's, which facilitates the creation of series of fladas and glo-lakes.	Contains the following assessed habitat types: fladas (coastal lagoons) and glo-lakes (coastal lagoons)
Coastal estuaries	High	The Baltic Sea's coastal estuaries differ from those elsewhere in Europe in that there are no tides and the water is brackish. Land uplift causes rapid primary succession in these estuaries. Land uplift does not take place to this extent anywhere else in Europe apart from Sweden and the White Sea.	Corresponds to the assessed habitat complex of the same name
BALTIC SEA COAST			
Coastal gravel, shingle and boulder shores	High	Due to the impact of ice ages and Finland's Precambrian bedrock, the Finnish coast and archipelago have an exceptional abundance of coastal areas composed of coarse-grained substrates compared with the more southern parts of the Baltic Sea. The development of the distinctive, perennial vegetation on coastal gravel, shingle and boulder shores is also affected by the water being brackish, the coast freezing over in the winter and the absence of tides.	Contains the following assessed habitat types: coastal stone and boulder shores, coastal gravel and shingle shores and coastal stony meadows
Coastal rock pools	High	Due to the impact of the Ice Age, the Precambrian bedrock is exposed on the coast and in the archipelago, unlike in the more southern parts of the Baltic Sea.	Corresponds to the assessed habitat type of the same name
Natural forest succession series of the land uplift coast	Particularly high	Land uplift does not take place to this extent anywhere else in Europe apart from Sweden and the White Sea. The topography of Finland's coast is less steep than Sweden's, which is why the forest succession series are more extensive.	Corresponds to the assessed habitat complex of the same name, which contains several assessed coastal forest and scrub habitat types

Barren islands succession series of the land uplift coast	Particularly high	Land uplift does not take place to this extent anywhere else in Europe apart from Sweden and the White Sea. The outer-archipelago conditions and soil of barren islands of the land uplift coast result in the formation of succession series of open habitat types.	Corresponds to the assessed habitat type complex of the same name
Islands and islets in the outer archipelago	High	Due to the impact of the Ice Age, the Precambrian bedrock is exposed on the coast and in the archipelago, unlike in the more southern parts of the Baltic Sea. Due to the shallowness of the marine area, there is a large number of islands.	Corresponds to the assessed habitat complex of the same name
Islets and cliffs with bird colonies	High	Due to the impact of the Ice Age, the Precambrian bedrock is exposed on the coast and in the archipelago, unlike in the more southern parts of the Baltic Sea. Due to the shallowness of the marine area there is a large number of islands. Vegetation on these islets is exceptionally lush and diverse due to the fertilising impact of the abundant breeding birds.	Corresponds to the assessed habitat complex of the same name
Baltic esker islands	Particularly high	Due to the impact of the Ice Age, glaciofluvial formations are abundant on the coast and in the archipelago of Finland, unlike in the more southern parts of the Baltic Sea.	Corresponds to the assessed habitat complex of the same name
INLAND WATERS AND SHORES			
Polyhumic lakes and ponds	High	A high proportion of mires in the catchment area causes high concentrations of humic substances (dystrophia) in lakes and ponds. Finland is one of the most mire-rich countries in Europe, and a high proportion of the habitat type is found in Finland.	Contains the following assessed habitat complexes: polyhumic lakes, shallow polyhumic lakes, mire ponds and small lakes
Northern *Stratiotes* lakes	High	Differ from more southern *Stratiotes* lakes due to the northern location and the special characteristics created by the Ice Age history.	Contains in part the following assessed habitat complexes: naturally eutrophic lakes, eutrophic ponds and small lakes (in the Kittilä area)
Lakes with groundwater influence	High	Often located in esker, end moraine or interlobate zones sculpted by the ice sheet.	Contains in part several assessed surface water body types
Small water bodies of glaciofluvial and glacial features	High	Eskers and end moraine complexes are significant drainage divides and the most important occurrence environment of spring complexes and many other freshwater bodies with groundwater influence. Small water bodies of glaciofluvial areas are rarer elsewhere because these areas are not as uniform and large in other countries as they are in Finland.	Contains in part the following assessed habitat complexes: esker ponds and small lakes, fell ponds and small lakes, spring ponds and small lakes, spring complexes, Cratoneurion spring complexes, intermittent streams in the fell area, first order streams in the fell area, headwater streams in the fell area, intermittent streams in the coniferous forest zone, first order streams in the coniferous forest zone and headwater streams in the coniferous forest zone.
Lake routes (chains of lakes)	Particularly high	A water body type characteristic of Finland, particularly in Finnish Lakeland, which does not occur to the same extent elsewhere. A significant habitat for many groups of organisms, including migratory fish populations of inland water bodies.	May contain almost all of the assessed river and lake types (especially in Finnish Lakeland).

Meandering streams and rivers	High	Meandering streams and rivers occur in glaciofluvial areas of Scandinavia, mainly in Finland and Sweden.	May contain almost all of the assessed stream and river habitat types.
Gravel and shingle lake and river shores	High	Usually occur in conditions shaped by the Ice Age where the soil consists of sorted glaciofluvial material, often in conjunction with esker and end moraine complexes.	Contains the following assessed habitat types: gravel and shingle lake shores and gravel and shingle river shores
Sand and fine sand shores and erosion banks of lakes and rivers	High	Usually occur in conditions shaped by the Ice Age where the soil consists of sorted glaciofluvial material, often in conjunction with esker and end moraine complexes.	Contains the following assessed habitat types: sand and fine sand lake shores, sand and fine sand shores and sandbanks of rivers, erosion banks on lake shores and erosion banks on river shores
MIRES			
Thin-peated and dwarf-shrub spruce mires	High	The focus of the occurrence of spruce mires dominated by the Norway spruce (*Picea abies*) and dwarf shrubs is on Fennoscandia. In addition to Finland, they occur in Russian Karelia, Sweden and Norway. In areas further in the east and on the Scandinavian Mountains, herb-rich spruce mires are more dominant. In Finland, the flat topography facilitates paludification.	Contains the assessed habitat type of thin-peated spruce mires and the assessed habitat type group of dwarf-shrub spruce mires
Frost bogs and mires	High	Occurrence focuses on northern parts of Norway, Finland, Sweden and Russia in the sporadic permafrost zone in the northern parts of the boreal zone and in the mountain birch zone.	Corresponds to the assessed habitat type group of the same name
Flark fens	Particularly high	Among the most typical mire types of northern boreal aapa mires. Occurs particularly in Finland in the middle and especially north boreal zone. Also in Northern Sweden and to some extent also in East Karelia. Mud-bottom flark fens, as well as oligotrophic flark fens with *Warnstorfia fluitans* and mesotrophic flark fens with *Sarmentypnum exannulatum* and *S. procerum* are especially characteristic of Finland.	Corresponds to the assessed habitat type of the same name
Rich birch fens	Particularly high	Occurrence focuses on Finland, on the Central Lapland Greenstone Belt in the north boreal zone. Occurs to some extent in Northern Sweden, too.	Corresponds to the assessed habitat type group of the same name
Rich flark fens	Particularly high	Occurs particularly in Finland, in the north boreal zone. Occurs in Northern Sweden, too, but for topographical reasons there are fewer extensive rich flark fens there than in Finland. Occurs to some extent in East Karelia, too.	Contains the following assessed habitat types: rich flark fens and rich *Calliergon richardsonii* flark fens
Concentric raised bogs	Particularly high	Occurrence focuses for climatic reasons on Finland on flat coastal land areas of Baltic Sea bays. The occurrence zone is clearly broader than in Sweden. Occurs with different vegetation in Estonia and Russia. Of the two subtypes of concentric bogs occurring in Finland, those particularly characteristic of Finland are the concentric raised bogs with pools of North Satakunta and South Ostrobothnia.	Corresponds to the assessed habitat complex of the same name
Northern reticulate raised bogs	High	Occurs in Finland mainly in Forest Lapland on flat ground, usually by water bodies. The same zone extends from Northern Sweden through Finland to the northern shore of the White Sea.	Corresponds to the assessed habitat complex of the same name

Aapa mires	High	The occurrence area of aapa mires extends from the Suomenselkä drainage divide and northern parts of North Karelia all the way to Fell Lapland and is divided into three sub-zones. The same zones are found in Sweden and Russian Karelia as well as in the Murmansk area. Aapa mires are also found to some extent in Norway. Particularly significant at the European level are the extensive flark-level and eutrophic aapa mires of Peräpohjola and Forest Lapland.	Contains the following assessed habitat complexes: middle boreal aapa mires, the southern subtype of northern boreal aapa mires and the northern subtype of northern boreal aapa mires
Sloping fens	High	Sloping fens occur in fell and hill areas whose local climate is characterised by humidity, coolness, high precipitation rates and thick snow cover. In Peräpohjola and Forest Lapland, groundwater influence plays a bigger role in the occurrence of sloping fens than in Kainuu and Koillismaa or elsewhere in Fennoscandia. In addition to Finland, sloping fens occur in Sweden and Norway.	Corresponds to the assessed habitat complex of the same name
Palsa mires	High	Besides Finland, palsa mires occur in Sweden, Norway and Russia. Both mound and plateau palsa mires occur in all of these countries.	Corresponds to the assessed habitat complex of the same name
Mire succession series of the land uplift coast	Particularly high	A habitat complex of the land uplift coast which in Europe occurs mostly and is at its most representative in Finland (although with very scant occurrences remaining). Occurs in Sweden on the coast of the Gulf of Bothnia only as a narrow zone due to topography. Occurs only in a narrow zone on the coast of the White Sea due to slow rate of land uplift.	Contains the following assessed habitat complexes: raised bog succession series of the land uplift coast, aapa mire succession series of the land uplift coast and succession series of small mires on the land uplift coast
FORESTS			
Northern boreal pine forests*	High	Typical of Finland in particular, these are continental-climate Scots pine (*Pinus sylvestris*) forests in the Fennoscandian Shield area. There is no permafrost and the coniferous timberline is formed by the Scots pine (Norway spruce, *Picea abies* further east).	Contains in part several assessed Scots pine-dominated heath forest habitat types (in the northern boreal zone)
Esker forests*	Particularly high	Eskers are representative in Fennoscandia and there is a large number of esker-related wooded environments in the region although they are no longer in a good state in terms of their quality. High significance for the preservation of responsibility species.	Contains the assessed habitat type of sun-exposed esker forests
Forests on rocky terrain*	High	The acidic siliceous rock outcrop area is a special feature of the Fennoscandian Shield. Forests on rocky terrain have also preserved a great deal of their characteristic features.	Corresponds to the assessed habitat type of the same name
ROCK OUTROPS AND SCREE			
Open roche moutonnées	High	In addition to Finland, roche moutonnées exposed from water by land uplift and smoothed by the continental glacier occur abundantly only in Sweden, Russia and Norway.	Contains the following assessed habitat types: acidic rock outcrops on seashores, acidic rock outcrops with *Racomitrium lanuginosum* and acidic rock outcrops with reindeer lichen and mosses

Strongly weathered rapakivi rock outcrops (composed of loose stones and gravel)	High	The habitat type occurs in the rapakivi granite area of southeastern Finland, on the south coast of Finland and on the Åland Islands. The same habitat type also occurs in rapakivi granite areas on the Russian side of the border as well as in Southern Sweden.	Contains in part the assessed habitat type of siliceous weathered rocks
Boulder fields of raised beaches	High	The type is found extensively in Finland and Sweden, perhaps to some extent in Russia and Norway.	Contains the following assessed habitat types: boulder fields of raised beaches near the Baltic coast (rather young) and boulder fields of raised beaches inland (ancient)
Frost-heaved boulder fields	High	Frost-heaved boulder fields occur especially in peripheral sections of mires. Although there is very little data on them of the rest of Europe, it is highly probable that Finland and possibly Sweden are priority areas for this habitat type. Finland is one of the most mire-rich countries in Europe and frost heaving is also strong due to the cold climate. The Fennoscandian Shield of the Earth's crust extends only slightly further east from Finland and it is presumable that the habitat type does not occur as a similar type in areas east of this area.	Corresponds to the assessed habitat type of the same name
SEMINATURAL GRASSLANDS AND WOODED PASTURES			
Seashore meadows on the land uplift coast	Particularly high	Due to the steeper topography, the strong land uplift area on the Swedish side does not feature meadows of this type as large as in Finland. With globally significant endemic species, too, and active speciation (subspecies, races, groups).	Contains in part the assessed habitat type group of seashore meadows (on the land uplift coast)
FELL HABITATS			
Empetrum-Lichenes mountain birch forests	High	The most oligotrophic mountain birch forest type, which occurs especially in slightly continental areas on dry sandy and gravelly till soils. Quite common in Finland but small in scale on the Scandinavian Mountains and the Kola Peninsula.	Corresponds to the assessed habitat type of the same name
Northern boreal mountain heaths in Koillismaa and Peräpohjola	High	Due to climatic factors, mainly crown snow load, the timberline on boreal fells is lower than what would be enabled by growing-season conditions. There are hardly any occurrences of corresponding boreal mountain heath zones elsewhere in Fennoscandia or on the Kola Peninsula. The total area of the habitat type is small.	Contains in part the following assessed habitat types: *Calluna* mountain heaths, *Empetrum* mountain heaths and *Myrtillus* mountain heaths (occurrences located in Koillismaa and Peräpohjola)
Frost-influenced heaths	High	The occurrence of frost-influenced heaths is caused by special climatic and soil conditions. These are found especially in the slightly continental area of Fell Lapland (especially the Kaldoaivi Wilderness Area), in locations with rather flat topography, in the ecotone of mineral soil and mires (aapa mires). The majority of frost-influenced heaths are located in the elevation zone of 200–350 m a.s.l. It is presumable that, in their most typical form, frost-influenced heaths do not occur elsewhere in Western Europe or on the Kola Peninsula. The nearest (limited) occurrences of corresponding habitat types are probably found as far as Siberia where continentality is stronger.	Corresponds to the assessed habitat type of the same name

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Action proposals 7

Each of the threat status assessment expert groups has drawn up 6–14 action proposals the implementation of which could improve the state of habitat types that have become threatened and prevent new habitat types becoming threatened. The action proposals are the expert groups' views on measures required and premised on the ecology of the habitat types. The proposals of the expert groups express what should be done in practice but do not seek to take a stand on which administrative or legislative measures or funding should be employed to implement them. The implementation of the actions and their economic, social and other impacts will be evaluated at a later stage as a standalone process.

Proposals for action were drawn up in a similar way by expert groups during the previous assessment of threatened habitat types, too. Following the completion of the assessment, the Ministry of the Environment requested statements from key stakeholders and authorities on the assessment results and action proposals. A broad-based working group on biodiversity (working group promoting the implementation and monitoring of the Strategy for the Conservation and Sustainable Use of Biodiversity in Finland for the years 2012–2020) appointed by the Ministry subsequently designated a working group to formulate an action plan to improve the status of threatened habitat types. A consultation round was held on the draft action plan, which was then finalised and published (Ministry of the Environment 2011). The implementation of the action plan was incorporated into Finland's Biodiversity Action Plan for 2013–2020 (Heikkinen et al. 2013).

The aim of Finland's Biodiversity Action Plan is that biodiversity loss in Finland will have been halted by 2020 and the favourable status of biodiversity and ecosystem services will be ensured by 2050. The results of the threat status assessment of habitat types now completed serve to confirm that biodiversity loss in Finland cannot be halted by 2020 – despite this being required by the Convention on Biological Diversity (CBD) and the EU Biodiversity Strategy. According to a report published by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the decline of biodiversity and ecosystem services is continuing at a rapid rate elsewhere in Europe and in Central Asia, too. For example, the extent of wetlands has declined by 50% in these regions since 1970 (IPBES 2018). However, the consequences of biodiversity decline have been overshadowed in public debate by the threats posed by climate change.

After the completion of the previous threat status assessment of Finland's habitat types, the Forest Biodiversity Programme for Southern Finland (METSO) was expected to be the tool enabling the effective implementation of the actions proposed in conjunction with the assessment. The implementation of the METSO Programme has, however, slowed considerably in recent years. In 2017, a total of EUR 21.6 million in funding for programme implementation was available at Centres for Economic Development, Transport and the Environment (ELY Centres) and the Finnish Forest Centre, whereas in the peak year of 2014 the amount was twice that at EUR 43.4 million (Koskela et al. 2018). There has been no increase in funding for the management of protected areas, either, regardless of the fact that new areas have been established. On the other hand, positive development has also taken place as many sectors have developed and introduced approaches that take biodiversity better into account. Utilisation of natural resources and changes in land use have, however, continued at such an intensive rate and across areas so extensive that efforts to reverse the declining trend in biodiversity have failed.

Reversing the negative trend in biodiversity would require both the adoption of new approaches and the wider application and increased effectiveness of tools that are already in use. In recent years, the applicability of biodiversity offsetting to compensate for adverse impacts on biodiversity has been explored in Finland (e.g. Nyrölä et al. 2011, Moilanen and Kotiaho 2017, Similä et al. 2017, Raunio et al. 2018). Biodiversity offsetting, or ecological compensation, means compensating for adverse impacts on biodiversity (biodiversity losses) caused by human activity in one place by increasing biodiversity (generating gains) somewhere else. Biodiversity offsetting aims to achieve No Net Loss (NNL) of biodiversity and/or ecosystem services, which is included in the targets of the EU Biodiversity Strategy (e.g. European Commission 2016).

Improvements in the state of habitat types would also be promoted by advancements such as the development of forms of and incentives for voluntary protection, co-funding provided by the private sector, and the mutual aims and benefits of the protection of habitat types and species being taken better into account. The action proposals also underline the importance of taking nature values and objectives concerning the state of water bodies into account amid the growth of the bioeconomy sector, government reforms and the transformation of statutory land use planning and the land use guidance system.

This chapter provides a broad summary of the total of 70 action proposals made by the expert groups. The action proposals are divided into three themes in the summary (sections 7.1–7.3). The various themes are, however, interconnected with each other as the need for more protected areas depends on how successful the preservation of habitat types and their structural features is outside protected areas through land use guidance, sustainable use of natural resources, and nature management. Good knowledge of occurrences and the state of habitat types and easy access to information in information systems in turn promote the safeguarding of habitat types outside protected areas.

7.1 Protection, management and restoration

Around a quarter (26%) of the action proposals relate to protected areas or management and restoration improving the state of habitat type occurrences. For seminatural grasslands and wooded pastures and for fell habitat types, the emphasis is mainly on means of improvement other than protection.

In most habitat type groups, the proposals draw attention to certain habitat types whose protection status must be improved in particular and at which protection should be targeted. Some proposals pertain to habitat types whose protection has hardly been addressed at all so far. These include flooded forests, dune forests, meandering streams and near-shore Baltic Sea underwater habitat types such as benthic habitats characterised by *Zostera marina* and benthic habitats characterised by Charales.

The action proposals also specify numerous habitat types whose safeguarding has already been identified as necessary but the actions taken have not sufficiently improved their situation. These include spring complexes in their natural state, other habitat types with groundwater influence, and rivers and streams in Southern Finland. Their safeguarding should be expanded to also cover sites which are in a semi-natural state. Protection and management measures should also be increased concerning herb-rich forests with deciduous (hardwood) trees[1] and eutrophic herb-rich forests, representative sun-exposed esker forests, calcareous and serpentine rock outcrops, sand shores of inland waters, and natural forest succession series of the land uplift coast located on the mainland coast and in the inner archipelago.

It is proposed that mire protection should be targeted especially at the most threatened mire habitat types, such as spruce mires, rich fens, wooded swamps, middle boreal aapa mires and mire succession series of the land uplift coast, and protection needs should also be examined regarding the Central Lapland Greenstone Belt. To implement the supplementation programme for mire protection and utilise the opportunities provided by the Forest Biodiversity Programme for Southern Finland (METSO), the marketing of nature conservation to landowners should be increased and operating models should be developed for the protection of mire entities with multiple landowners. The protection of mires already designated for protection in regional land use plans must be implemented and area reservations for protection should be made in new regional plans as well.

In forest protection, it is important to preserve old-growth forests and individual old trees as the ecological quality provided by ageing cannot be recovered through restoration or nature management in a reasonable period of time. Natural forest succession stages created following storms, forest fires and other natural disturbances are also very rare and ecologically special habitat types, and it may be impossible to create them artificially.

Alongside the protection of individual habitat type occurrences, there is also an emphasis on the need to preserve more extensive entities so that natural processes will be able to function and maintain structural features important to habitat types. If the processes cannot be maintained naturally, their lack must be compensated for through nature management and restoration. Over the long term, however, protection is less expensive and more certain to produce the desired outcome. The action proposals also emphasise the improvement of the quality and functioning of the network of protected areas, such as the improved safeguarding of the hydrology of protected mires.

Protection of habitat types also benefits the protection of species and vice versa. The action proposals specifically mention species values in the context of the protection of calcareous rock outcrops. Employing natural solutions when removing barriers to fish migration in turn also improves the state of stream habitat types at the same time.

Nature management and restoration are needed both within and outside protected areas. Climate change is increasing the need for the management of a number of habitat types even further. Nature management is required especially for many forest habitat types and for open environments suffering from overgrowth. Accordingly, nature management is proposed especially for sun-exposed esker forests, forests with deciduous (hardwood) trees, seashores and shores of inland waters, bird wetlands, sands, calcareous rock outcrop habitat types as well as for seminatural grassland and wooded pastures, as eutrophication has resulted in lower diversity in the structural features and species of

1 Norway maple (*Acer platanoides*), hazel (*Corylus avellana*), common ash (*Fraxinus excelsior*), common oak (*Quercus robur*), small-leaved lime (*Tilia cordata*), wych elm (*Ulmus glabra*), European white elm (*Ulmus laevis*).

these environments. Eutrophication has many causes, such as a lack of forest fires, discontinuation of grazing, atmospheric nitrogen deposition, fertilisation and littoral eutrophication of water bodies.

Seminatural grasslands and wooded pastures have a special status in nature management because their preservation always requires active, appropriate management, such as grazing, mowing or clearing. The management of seminatural grasslands and grazed woodlands in protected areas must be organised, but this is only enough to safeguard around a quarter of the targeted extent of management. The number of managed sites must be increased and the quality of management improved.

Nature management also includes removing invasive alien species from the natural environment and preventing them from spreading. Examples of invasive alien species causing a significant decline in the state of threatened habitat types include the rugosa rose (*Rosa rugosa*), which is colonising sandy seashores very efficiently. In recent years, several steering instruments have been developed to control alien species, such as the EU Regulation on Invasive Species (IAS Regulation), Finland's National Strategy on Invasive Alien Species, the Act on Managing the Risks Caused by Invasive Alien Species and the Ballast Water Management Convention of the International Maritime Organization (IMO) ratified by Finland in 2016. From the habitat types perspective, the essential point is to secure management resources for the elimination of invasive alien species.

Restoration can help speed up the return of human-altered ecosystems to a semi-natural state and at the same time also improve the connectivity of habitat type occurrences. Among the action proposals, the need for restoration is emphasised for mire and forest habitat types as well as for small water bodies. The most important restoration method for heath forests is controlled burning, which can help return their natural succession process and ecologically important structural features (burnt wood, deadwood, deciduous trees). Burning can also prevent the eutrophication of barren heath forests, xeric heath forests, esker forests and other highly oligotrophic forest habitat types.

7.2

Land use, natural resource use and the state of the environment

Almost half (46%) of the action proposals are related to taking habitat types better into account in land use planning, natural resource use or efforts to improve the state of the environment. In this context, the state of the environment refers, among other things, to eutrophication of water bodies, air pollution and climate change, which may have very long-ranging impacts on habitat types, and these impacts are often indirect, without human activity directly targeted at the affected habitat type occurrences. Not even protected areas are able to protect habitat types against such large-scale adverse effects.

A poor state of the environment affects underwater habitat types in particular both in the Baltic Sea and in inland waters. Eutrophication and increasing turbidity of water are such serious problems, especially for the Baltic Sea, that opportunities to improve these habitat types through protection measures have decreased. The Programme of Measures of Finland's Marine Strategy 2016–2021 proposes several measures to reduce eutrophication (Laamanen et al. 2016). These include cutting nutrient loading from the drainage basin, nutrient recycling, improving habitats of sensitive marine species, removing nutrients through increased use of fish fodder made from raw materials produced in the Baltic Sea region and use of cyprinids as human food, increasing knowledge of the internal loading of the Baltic Sea, and cutting emissions from maritime transport through international cooperation. Achieving improvements in the state of threatened Baltic Sea habitat types calls for the rapid and efficient implementation of these proposals.

Reducing Baltic Sea eutrophication is also necessary for the state of many coastal habitat types such as sand beaches suffering from overgrowth and algal masses. It is also important to guarantee the safety of oil and chemical transport in the Baltic Sea as well as preparedness for accidents. Actions against eutrophication on land areas are needed for habitats such barren forest types, sands and rock outcrops threatened by overgrowth and, in particular, for seminatural grasslands and wooded pastures.

Many of the action proposals emphasise the need to examine sufficiently large entities of areas in order to reduce adverse effects on habitat types over the long term, too. With regard to inland waters, the focus in the protection and restoration of water bodies must be expanded from the immediate surroundings of individual channels and basins to entire catchment areas, for which there are already good tools available, such as the water body modelling tools for forestry and agriculture and the river basin management planning process. Especially in Southern Finland, more efficient agricultural measures to protect water bodies and restoration of catchment areas as well the comprehensive improvement of rivers, streams and their shores are required. In Baltic Sea areas, the emphasis is on taking threatened habitat types into account in marine spatial planning and zoning.

Measures altering mire habitats must be aimed at sites that have already been drained and have lost their nature values. At the same time, multitargeted land use planning at the drainage basin level, where the ecosystem services provided by undrained mires are identified and also safeguarded, should be promoted. In the fell area, growing tourism and increasing interest in the exploitation of northern natural resources call for comprehensive planning where fell habitats and reindeer pastures are taken into account. The fragmentation of reindeer pastures further increases the wearing effect of grazing on fell habitat types.

There is an emphasis in the action proposals relating to forestry on preserving and increasing the ecologically most important structural features of forests, such as individual old trees, deadwood and deciduous trees native to sites – particularly the aspen (*Populus tremula*), goat willow (*Salix caprea*) and deciduous (hardwood) trees. The collection of large deadwood for energy use and soil preparation destroying downed trees must be avoided.

Silviculture modelled on the natural structures and development of forests can help reduce the continuous qualitative decline of forest habitat types. Continuous-cover forestry is also recommended to improve the state of mire types such as spruce mires and pine mires and bogs. Forest operations should also safeguard the nature values of shady rock faces more comprehensively than is currently the case.

Seminatural grasslands and wooded pastures are the most threatened among the habitat type groups, and they also form a clear separate entity in the planning of actions. The preservation of seminatural grasslands and wooded pastures depends, above all, on agricultural policy and agricultural support systems. These factors play a key role for efforts to safeguard the continuous management of seminatural grasslands and wooded pastures, and they must be developed for systematic increases in the quantity and quality of these habitat types. National support is required for the management of seminatural grasslands and wooded pastures not covered by the EU's agri-environmental measures.

The state of fell habitat types is affected by guidance methods regulating reindeer grazing pressure. The action proposals emphasise the development of pasture rotation and the determination of reindeer counts by taking the state and sustainability of fell habitat types and pastures into account. Increasing the share of pasture areas only used for winter grazing would improve the state of fell habitat types suffering from mechanical wear.

Many of the action proposals underline the expert assessment of the environmental impacts of projects with adverse effects on habitat types as well as expert planning of projects and improved preparedness for the avoidance, mitigation and offsetting of adverse effects of projects. Habitat types mentioned in this context include mire entities and calcareous and serpentine rock outcrops suffering from mining projects, Baltic Sea habitat types suffering from dredging and disposal of dredged material as well as habitat types threatened by construction. Improving the quality and availability of datasets concerning habitat type occurrences would increase opportunities to mitigate adverse impacts of projects.

Action proposals are also given for areas withdrawn from commercial use whose nature has already been altered. The recovery of threatened species of calcareous and serpentine rock outcrops can be supported through correct aftercare of closed quarries where part of the rock exposures are left steep and uncovered. When planning the further use of low-productive ditch-drained areas withdrawn from forestry use, particular attention should be paid to improving the state of mire habitats.

No action proposals relating to climate change mitigation were prepared for the habitat type groups as these were regarded as falling within the sphere of general climate policy. Action against climate change and mitigation of its adverse impacts is, however, extremely important for all of the habitat type groups. It is difficult to anticipate the specific impacts of climate change at the habitat type level, but climate change is projected to intensify the adverse effects of eutrophication and several other environmental problems that are already serious. This increases the need for habitat type management, restoration and remediation outside protected areas, too. Reciprocally, the use and restoration of mires and forests affect the size of carbon pools and, consequently, climate change.

7.3

Research, monitoring, information systems, education and training, and communications

More than a quarter (29%) of the action proposals are to do with increasing and disseminating knowledge about habitat types and improving access to information.

Although knowledge about the quantitative and qualitative development of habitat types has improved in a few habitat type groups compared with the first assessment of threatened habitat types in Finland, further knowledge is required about all of the habitat type groups. The results of the Finnish Inventory Programme for the Underwater Marine Environment (VELMU) enabled the description of the characteristics of a larger number of underwater habitat types of the Baltic Sea, but around a third of the types still had to be classified as Data Deficient (DD) and it was not possible to assess their threat status. The launch of a VELMU 2 project, that is a new inventory programme for underwater marine habitat types, was also recommended by the programme of measures of Finland's Marine Strategy (Laamanen et al. 2016).

Several shore habitat types of inland waters were also classified as Data Deficient (DD). There is also a lack of data about water body sites of protected areas, and it is proposed that their quantity, state and restoration needs be evaluated habitat type-specifically. Hydrological research has been conducted in Finland for a long time, but habitats such as lakes that are strongly influenced by groundwater have not been addressed as separate units. Likewise it is proposed that a basic inventory be conducted on the entire coast, utilising remote sensing and field inventories, as the coast has largely been excluded from previous thematic inventories.

Although Finland's forests are known well in many ways, heath forests are the only habitat type group with sufficiently comprehensive data on areas and quality variables, thanks to the National Forest Inventory (NFI), to enable threat status assessments to be conducted based on quantitative data. Forest mapping and monitoring of the state of forests are proposed to be targeted especially at herb-rich forest types, which are important for biodiversity, and at special forest habitats, such as esker forests.

The importance of the completion of the regional inventories of seminatural grasslands and wooded pastures is emphasised, and so is that of the comprehensive entry of data in the Finnish compartment data system for protected areas (SAKTI) so that management sites of these habitat types can be prioritised taking the results of the new threat status assessment into account. Improving habitat type occurrence and characteristics data is proposed also for serpentine rock outcrops, old limestone quarries and intermediate-basic rock outcrops, which are important for rock outcrop species. As regards mires, it is proposed that more knowledge be gained also about regional biodiversity hotspots such as the Central Lapland Greenstone Belt.

Highlighted among current data needs is a survey of habitat types most vulnerable to climate change especially among fell, aquatic and shore habitats affected by climate change through multiple factors. Research into ecosystem services provided by habitat types is proposed regarding habitat type groups including mires and seminatural grasslands and wooded pastures.

There is currently very little monitoring of the state of habitat types in Finland, and the action proposals call for the development of monitoring based on remote sensing in particular. The method is well-suited for, for example, fell habitat types. The importance of safeguarding the continuity of reindeer pasture inventories is also emphasised in the context of fell habitats.

Finland has a long tradition of water body monitoring, but the monitoring programmes do not cover small water bodies. It is therefore proposed that biological monitoring relating to water management and the classification of the ecological state of water bodies be expanded to cover springs, headwater streams, intermittent streams, ponds and small lakes. It is proposed that trends in the state of shores of freshwater bodies be monitored in conjunction with, for example, aquatic plant and zoobenthos monitoring and by using remote sensing methods. The type of monitoring proposed for seminatural grasslands and wooded pastures is systematic photographic monitoring.

The effectiveness of management measures should be monitored in those habitat types where there is a clear need for management but where there is not much previous experience of management. Examples of these include calcareous rock outcrops. The management of seminatural grasslands and wooded pastures is a more established practice, but there, too, the impacts of management methods on the various habitat types, groups of organisms and nutrient economy as well as on the economic viability and the effectiveness of incentives must be monitored.

The need for geographic datasets and shared information systems for habitat type occurrence data are recurrent themes in the action proposals. Data should be accessible as freely as possible so that no more valuable habitat type sites are destroyed alongside land use changes and exploitation of natural resources due to lack of information. For this purpose, either a new geoportal for habitat types should be established or existing, widely used geoportals should be developed further. Increased stock of and improved access to information would benefit activities such as the evaluation and development of opportunities for biodiversity offsetting.

The further development of broadly available internet services and other exchange of information is proposed in order to find and convey management sites, grazing animals, tools and guidelines relating to seminatural grasslands and wooded pastures, for example. In addition, the various actors must develop their mutual exchange of information, for example in the case of seminatural grasslands and wooded pastures between environmental and agricultural administration. As regards the marine environment, it is proposed that information packages tailored for actors in various sectors be produced concerning the environmental impacts of activities and the means available to improve the state of the marine environment.

The action proposals also emphasise the need to maintain and develop competencies relating to habitat types in degree and training programmes of universities and other education institutions. Content relating to fell habitats is proposed for inclusion in natural resources and tourism studies at northern educational institutions.

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Summary

This publication includes the results of the second assessment of threatened habitat types in Finland. The second assessment was carried out between 2016 and 2018 and published ten years after the first assessment. The need for information on the state of habitat types and on changes in their state has increased during this time. A more comprehensive understanding of the state of biodiversity is needed to evaluate the progress made towards the biodiversity targets set for 2020 and as background material for the planning of post-2020 measures. After the first assessment of Finland's threatened habitat types, there has been an improvement in basic knowledge especially concerning Baltic Sea underwater habitat types, inland waters and mires. The assessment was carried out by broad-based expert groups, which included more than 120 specialists in ecology, hydrobiology, forestry, geology, geography and other fields from research institutes, universities and administration. The project was coordinated by the Finnish Environment Institute.

The first assessment of threatened habitat types in Finland (Raunio et al. 2008) utilised a nationally developed assessment method because the International Union for Conservation of Nature (IUCN) had yet to develop a method suitable for the global assessment of habitat types. The second assessment of threatened habitat types in Finland utilised the IUCN's Red List of Ecosystems Categories and Criteria (IUCN 2015), a new assessment method intended for habitat types. Its basic principles for assessing changes in the quantity and quality of habitat types are similar to Finland's national method, but there are also differences between the two.

The assessment examined all the habitat types found in Finland, and these were divided into eight main groups:

- Baltic Sea
- Baltic Sea coast
- inland waters and shores
- mires
- forests
- rock outcrops and scree
- seminatural grasslands and wooded pastures
- fell habitats.

The concept of *habitat type* is defined as follows: **Habitat type refers to spatially definable land or aquatic areas with characteristic environmental factors and biota that are similar between these areas but that differ from areas of other habitat types.** The environmental factors include soil, climate and topography. The characteristics of the biota include the composition of typical species and their relative abundances. Habitat type can refer to varying units which differ in their size or degree of internal variation. In addition to habitat types, the assessment takes into consideration the most commonly occurring *habitat complexes.*

During the second assessment, the list of assessed units, that is, the classification system for habitats, was modified to some extent. The classification was revised and made more specific especially for underwater habitat types in the Baltic Sea. The number of habitat types described and assessed in this group was four times larger than in the previous assessment. The classifications of most of the other groups of habitat types only underwent small changes, but the classification of heath forests was simplified considerably. The results are listed according to the lowest assessed level of hierarchy, which means that there are a total of 388 habitat types or habitat complexes.

The second part of the final report in Finnish includes descriptions, general distribution maps and photographs of the assessed habitat types. It also includes habitat type-specific justifications for the results of the assessment.

Threat status assessment method

The IUCN's new assessment method comprises five criteria for assessing the risk of collapse of each habitat type (Figure 8.1). The decline leading up to collapse can progress in various ways depending on the habitat type, and the IUCN's assessment protocol groups symptoms of collapse into four major types that are described by criteria A, B, C and D of the method.

In the IUCN method, two of the criteria are linked to the quantity and geographical distribution of the habitat type. Criterion A examines declines in distribution (reduction in quantity), which reduces the carrying capacity of the habitat type for dependent biota. Criterion B is related to restricted distribution, which predisposes the habitat type to spatially explicit threats.

The two other criteria in turn examine functional changes in the occurrences of the habitat type. Criterion C assesses the degradation of the abiotic environment, reducing habitat quality or abiotic niche diversity for component biota. Criterion D focuses on the disruption of biotic processes and interactions, resulting, for example, in the loss of mutualisms, biotic niche diversity, or exclusion of some component biota by others.

The fifth criterion (E) is related to the combined impact of the factors that lead up to the collapse of a habitat type. The progression of a habitat type is described through modelling, which produces a quantitative estimate of the risk of collapse.

These five criteria form the foundation of the IUCN's Red List of Ecosystems protocol. The habitat type under consideration is assessed with all the criteria for which data or expert inputs are available. The overall risk status of the ecosystem type is assigned as the highest category of risk obtained through any criterion and the end result is one of the following categories:

CO	Collapsed
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern
DD	Data Deficient
NE	Not Evaluated

Changes to habitat types are assessed over the course of four specified periods. Past changes refer to the last 50 years, and future changes refer to changes that will take place over the next 50 years, or a 50-year period that includes both the past and future. Historical changes are assessed in relation to the status of the habitat type around 1750, which marked the time at which global industrialisation and intensive exploitation of ecosystems began.

In addition to the nationwide assessment of threatened habitat types, the threat level of each habitat type was examined separately for Southern Finland and Northern Finland (Figure 8.2), because in different parts of Finland there are great differences in the scope of human activities and between the threats faced by habitat types.

After the first assessment of threatened habitat types in Finland, new data has been produced on many habitat types and new information on habitat types has been gathered through geographical information analyses, new calculations and combination of data. Important reference data for the assessment has included the National Forest Inventory (NFI) by the Natural Resources Institute Finland, the habitat type inventory data of Metsähallitus, the Finnish Inventory Programme for the Underwater Marine Environment (Velmu), data related to the supplementation programme for mire protection, and the environmental administration's data

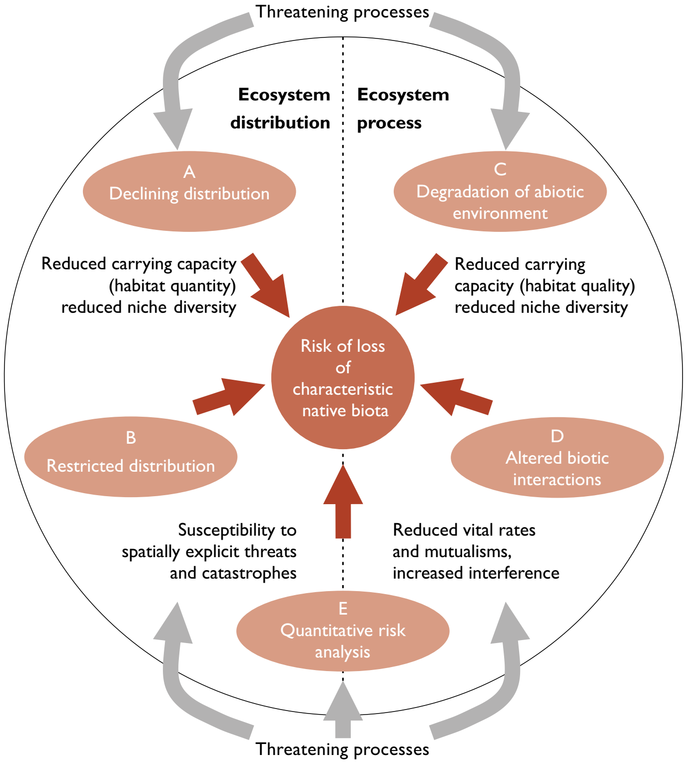

Figure 8.1. IUCN criteria used in the assessment of threatened habitat types and their connection to risk of collapse (Keith et al. 2013).

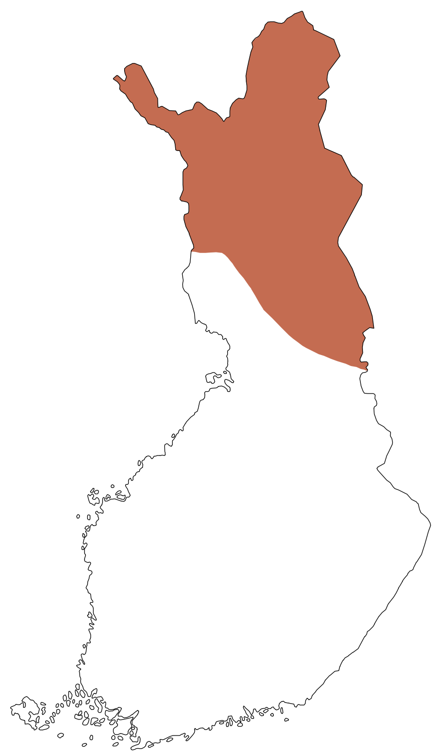

Figure 8.2. Division of Finland into subregions for the threat status assessment of habitat types. Marked in white, Southern Finland corresponds to the hemiboreal, south boreal and middle boreal forest zones and, marked in maroon, Northern Finland corresponds to the north boreal zone.

on the typology of surface waters and the classification of their ecological status and water quality.

Significant new geospatial studies were carried out for the assessment, for example, on the determination of fell areas, the drainage of mires, changes to land use surrounding ponds, the occurrence of meandering rivers, the reduction in sand beaches, the current state of palsa mires, the occurrence of esker and dune forests, and the extent of mountain birch forest loss.

Results of the assessment of threatened habitat types in Finland

Overall results

A total of 388 habitat types and habitat complexes were assessed in the whole country, 317 in Southern Finland and 253 in Northern Finland (at the lowest, i.e. most specific level of classification). The number of assessed units varied in the nationwide assessment from 34 for forest habitats to 69 for mire habitats.

Of the habitat types, 48% (186) are threatened (CR, EN or VU) in the whole country, 59% (186) are threatened in Southern Finland and 32% (81) are threatened in Northern Finland (Figure 8.3). There are 57 (15%) Critically Endangered (CR) habitat types nationwide and, of these, 40 are seminatural grasslands or wooded pastures. Other habitat types that were also assessed as CR include coastal dunes, streams in southern clay-dominated catchment areas and snowbeds in fell areas.

In the nationwide assessment, 52 (13%) Endangered (EN) and 77 (20%) Vulnerable (VU) habitat types were identified. Under the current habitat type classification system, no habitat type was listed as Collapsed (CO).

There are 71 (18%) Near Threatened (NT) and 91 (23%) Least Concern (LC) habitat types in the whole country. This means that, among all of the Red List categories, LC is the largest category, and habitat types assessed as LC are

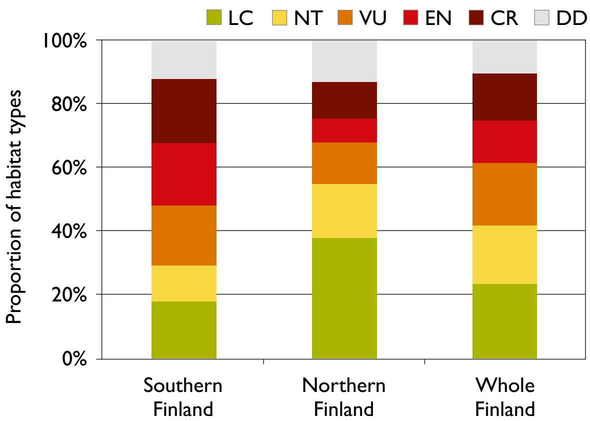

Figure 8.3. Breakdown of habitat types into IUCN Red List Categories by percentage of number of habitat types in Southern Finland (317 habitat types), Northern Finland (253) and in the whole of Finland (388). Habitat types and habitat complexes at the lowest level of the classification are included.

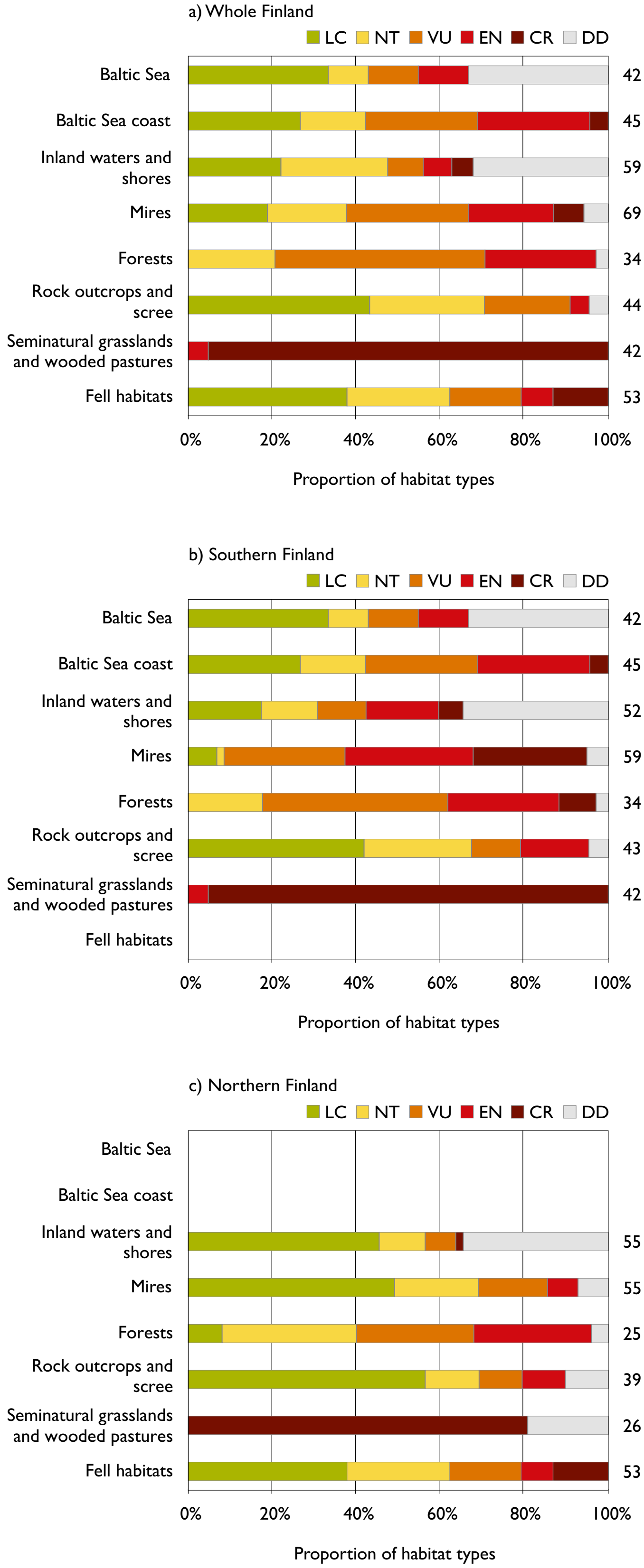

Figure 8.4. Breakdown of habitat types into IUCN Red List Categories in the whole of Finland, Southern Finland and Northern Finland by main group of habitats (percentages of numbers of habitat types at the lowest level of hierarchy). Figures on the right show the numbers of assessed habitat types for each of the main groups in the given region.

LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, CO = Collapsed, DD = Data Deficient

distributed fairly evenly among the various habitat type groups, with the exception of seminatural grassland and wooded pasture and forest habitat types. Environments where human impacts are low due to a remote location or difficult-to-access terrain have been assessed as LC. The LC category also includes habitat types whose area has increased over the past decades and for which no significant quality decline has been observed (e.g. coastal reedbeds with *Phragmites australis*). Among Baltic Sea habitat types, those assessed as LC include benthic habitat types whose species tolerate or even benefit from eutrophication.

A total of 40 habitat types (10%) were assessed as Data Deficient (DD) in the whole country. These are mainly habitat types included in the assessment as new ones, such as new Baltic Sea and inland water and shore habitat types that were not included in the previous assessment.

Results by habitat type group

Threatened habitat types account for the highest percentage of habitat types in terms of number at the nationwide level among seminatural grasslands and wooded pastures (100%) and forest habitat types (76%) and for the lowest percentage among inland water (20%), Baltic Sea (24%) as well as rock outcrop and scree (25%) habitat types (Figure 8.4a). Among inland water and Baltic Sea habitat types, the rather low percentages of threatened habitat types are partly explained by the higher percentage of Data Deficient (DD) types compared with other habitat type groups.

The percentage of Critically Endangered (CR) habitat types is clearly highest among seminatural grasslands and wooded pastures (95%) (Figure 8.4a). The highest percentage of Endangered (EN) and Vulnerable (VU) habitat types can be found in the Baltic Sea coast, mire and forest habitat type groups. The percentages of Near Threatened (NT) habitat types in turn are the highest in the inland water and shore, forest, rock outcrop and scree, and fell habitat type groups.

In general, the percentage of threatened habitat types is higher in Southern Finland (59%) than in Northern Finland (32%) (Figure 8.3). The difference is along the same lines in all of the assessed habitat type groups in Southern as well as Northern Finland. The biggest differences in assessment results can be seen in the mire and inland water habitat type groups (Figure 8.4b–c). This is affected especially by differences in land use intensity: in Northern Finland, the rate of ditch drainage of mires and mineral soils has been lower, the share of cultivated land and constructed areas is smaller, the nutrient loading of water bodies has been lower and the share of areas protected in various ways is considerably higher than in Southern Finland.

Results by area covered

In the section above, the results of the assessment are presented as percentages by number of habitat types. However, the area covered by a habitat type can vary significantly, and data is therefore also needed on the proportions of area covered by habitat types in the various Red List categories. The known, rather rough estimates of area can be used to estimate indicative threatened, Near Threatened (NT) and Least Concern (LC) habitat type area proportions for just under 70% of Finland's area. The calculation includes lakes, ponds, undrained mires, heath forests, rock outcrops and scree, seminatural grasslands and wooded pastures, and fell habitats. Around 50% of the total area of these habitat type groups belongs to habitat types that are classified at the nationwide level as threatened (CR, EN, VU), just over 40% to NT ones and around 6–7% to LC ones.

The percentage of the area of threatened habitat types is in the same range as their proportion in terms of their number, but the area percentages of NT and LC habitat types differ quite clearly from their percentages calculated on the basis of their number. In the whole country, NT habitat types account for 18% of the number of habitat types but for more than 40% of their estimated area. LC habitat types account for 24% of the total number of habitat types but for only 6–7% of their area. The difference is explained by the fact that many particularly large-sized habitat types have been assessed as NT. Examples of these include many lake types, oligotrophic pine mire and bog types and, for example, the most extensive individual forest habitat type – mature conifer-dominated mesic heath forests.

Trends

Habitat types were also assessed concerning the current and near-future trends of their state. Trends are not included in the IUCN assessment methodology. Instead, this is additional data assessed for national needs. The trend for 57% of habitat types in the whole country and for 62% in Southern Finland was regarded as declining, whereas the trend for more than half (51%) of the habitat types in Northern Finland was regarded as stable. In the whole country, only 5% of the habitat types were assessed as undergoing an improving trend. Examples of these include such Baltic Sea and coastal habitat types that benefit rather than suffer from eutrophication. The trend for around 9% of the habitat types could not be assessed.

Reasons for becoming threatened and threat factors

The reasons for habitat types becoming threatened refer to the past or present causes that have led up to the current state of the habitat type. Reasons have been listed for threatened and Near Threatened habitat types and, in some cases, also for Data Deficient habitat types. Future threats in turn include factors that will impact habitat types in the future, and these have been listed for habitat types of Least Concern, too, if necessary.

Forestry (F), ditch drainage (DR), clearing for agriculture (AGCL), construction (CST) and eutrophication of waters (WEP) were deemed the most important reasons for habitat types becoming threatened. Forest operations (F) were listed as one of the top three reasons for coastal habitat types, mires, rock outcrops and scree, and seminatural grasslands and wooded pasturer becoming threatened. The forestry-related reasons for forest habitat types being threatened were listed in more detail in the assessment. These include reduction in coarse woody debris (deadwood) (FCWD), reduction in old-growth forests and individual old trees, including the decreasing number of large trees (FOG) as well as changes in tree species composition (FTS).

Ditch drainage (DR) is the most significant reason why mires are threatened but it has also harmed small streams and ponds and the habitats of many other moist or mesic sites. Clearing for agriculture (AGCL) is an important reason why especially rich mire and herb-rich forest habitats and seminatural grasslands and wooded pastures have become threatened. Construction on land (CST) is the fourth most significant reason, and it was identified as a reason quite equally among all terrestrial habitat groups. Eutrophication and non-toxic pollution of waters (WEP) is the most significant reason for the Baltic Sea's underwater habitat types and many lake and pond habitat types being threatened.

The relative significance of future threat factors is largely similar to that of the reasons for habitat types becoming threatened. The significance of clearing for agriculture (AGCL) is, however, clearly higher as a reason for habitat types becoming threatened than as a future threat, whereas the significance of climate change (CC) and of invasive alien species (IAS) is higher as a threat than as a reason. Climate change is mentioned as a future threat in this assessment for more than 150 habitat types, around twice the figure of the previous assessment. This change is due to both the advancement of climate change as well as to improved awareness of its impacts.

Comparison with previous assessment

The results of the first assessment of threatened habitat types in Finland published in 2008 and of this new assessment are not directly comparable. This is because the new assessment was carried out using the IUCN RLE method (IUCN 2015), while the first assessment utilised a national assessment method (Raunio et al. 2008). However, the reasons for the changed threat categories for habitat types have been investigated.

When assessed concerning the whole of Finland, nearly half of habitat types (44%) were placed in the same IUCN Red List category in both the 2008 and the 2018 assessment. The classification that has remained the most unchanged is Least Concern (LC), but the habitat types in other categories have also remained the same for the most part. The exceptions to this are Data Deficient (DD) habitat types, the majority of which were added to this second assessment as new habitat types.

At the nationwide level, in most cases (88%) a reclassification was due either partially or entirely to a change in the method of assessment. Around one third of category changes were due to an increase in knowledge about the habitat type, and approximately 11% were related to a change in the classification of the habitat type. Many reasons are often given for uplistings or downlistings, but the most common individual reason is change in method. Genuine change was identified in 22 cases of reclassification (15%), and, with the exception of one assessment, this change resulted in uplisting. The results can be interpreted to mean that the threat of collapse for habitat types has not lessened, although halting biodiversity loss by 2020 has been both a national and a European Union target.

Action proposals

The expert groups have listed 70 proposals for actions that would improve the state of threatened and Near Threatened habitat types and that would prevent negative trends in other habitat types. The action proposals concern protection, management and restoration of habitat types; land use, natural resource use and the state of the environment; and research, monitoring, information systems, education and training, and communication. The starting point for the preparation of these proposals was the ecology of habitat types. The implementation of the actions and their economic, social and other impacts will be evaluated at a later stage as a standalone process.

Finland's habitat types of national responsibility

Finland's first assessment of threatened habitat types involved the preparation of a list of Finland's habitat types of national responsibility once the criteria for their selection had first been produced. Finland's responsibility for the preservation of a habitat type is:

- *particularly high* if a very significant proportion of Europe's representative occurrences is located in Finland. A proportion which can be regarded as the guideline value for a very significant proportion is more than 40% of the number or area of the habitat type's occurrences.
- *high* if a significant proportion of Europe's representative occurrences is located in Finland. A proportion which can be regarded as significant is 25–40% of the number or area of the habitat type's occurrences.

Some changes were made to the list during the second threat status assessment of Finnish habitat types. These mainly entailed additions within the Baltic Sea, coastal, inland water and shore, mire as well as rock outcrop and scree habitat type groups. A total of 44 responsibility habitat types have been designated, of which 15 are habitat types of a particularly high responsibility and 29 are habitat types of a high responsibility. Finland's habitat types of national responsibility fall under the habitat type groups as follows:

- **Baltic Sea:** benthic habitats characterised by Charales, benthic habitats characterised by *Zostera marina*, rocky bottoms of the Baltic Sea, benthic habitats characterised by aquatic moss, pelagic habitats of northern Baltic Sea, sea ice, succession series of fladas and glo-lakes (coastal lagoons) on the land uplift coast, coastal estuaries.
- **Baltic Sea coast:** coastal gravel, shingle and boulder shores, coastal rock pools, natural forest succession series of the land uplift coast, islands and islets in the outer archipelago, islets and cliffs with bird colonies, Baltic esker islands.
- **Inland waters and shores:** polyhumic lakes and ponds, northern *Stratiotes* lakes, lakes with groundwater influence, small water bodies of glaciofluvial areas, lake routes (chains of lakes), meandering streams and rivers, gravel and shingle lake and river shores, sand and fine sand shores and erosion banks of lakes and rivers.
- **Mires:** thin-peated spruce mires and dwarf-shrub spruce mires, frost bogs and mires, flark fens, rich birch fens, rich flark fens, concentric raised bogs, northern reticulate raised bogs, aapa mires, sloping fens, palsa mires, mire succession series of the land uplift coast.
- **Forest habitats** of national responsibility were not examined during this assessment. They are the same as they were in the first assessment (Tonteri et al. 2008): northern boreal pine forests, esker forests, forests on rocky terrain.
- **Rock outcrops and scree:** open roches moutonnées, strongly weathered rapakivi rock outcrops (composed of loose stones and gravel), boulder fields of raised beaches, frost-heaved boulder fields.
- **Seminatural grasslands:** seashore meadows on the land uplift coast.
- **Fell habitats:** *Empetrum-Lichenes* mountain birch forests, northern boreal mountain heaths in Koillismaa and Peräpohjola, frost-influenced heaths.

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Appendix 1: IUCN Red List of Ecosystems criteria (IUCN 2015)

A. **Reduction in geographic distribution** over any of the following time frames:

Subcriterion	Time frame	CR	EN	VU
A1	Past (over the past 50 years)	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years)	≥ 80%	≥ 50%	≥ 30%
A2b	Any 50 year period (including the past, present and future)	≥ 80%	≥ 50%	≥ 30%
A3	Historical (since approximately 1750)	≥ 90%	≥ 70%	≥ 50%

B. **Restricted geographic distribution**

B1. Extent of a minimum convex polygon (km²) enclosing all occurrences (extent of occurrence, EOO) is:			
CR	2 000 km²	AND at least one of the following (a-c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exist at: 1 location
EN	20 000 km²	AND at least one of the following (a-c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exist at: 5 location
VU	50 000 km²	AND at least one of the following (a-c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exist at: 10 location

B2. The number of 10×10 km grid cells occupied (area of occupancy, AOO) are:

CR	2	AND at least one of the following (a-c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exist at: 1 location

EN	20	AND at least one of the following (a-c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exist at: 5 location
VU	50	AND at least one of the following (a-c):	a) An observed or inferred continuing decline in ANY OF: i. a measure of spatial extent appropriate to the ecosystem; OR ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem: OR iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. c) Ecosystem exist at: 10 location

B3. A very small number of locations:	
VU	A very small number of locations (generally fewer than 5) AND prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of Collapse or becoming Critically Endangered (CR) within a very short time period (B3 can only lead to a listing as Vulnerable, VU).

C. Environmentzal degradation over the following time frames:

		Relative severity (%)		
	Extent (%)	≥ 80	≥ 50	≥ 30
C1. The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		
		Relative severity (%)		
C2a. The next 50 years, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; OR **C2b.** Any 50-year period including the past, present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 80	≥ 50	≥ 30
	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		
		Relative severity (%)		
	Extent (%)	≥ 90	≥ 70	≥ 50
C3. Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
	≥ 70	EN	VU	
	≥ 50	VU		

D. Biotic disruption over the following time frames:

		Relative severity (%)		
	Extent (%)	≥ 80	≥ 50	≥ 30
D1. The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		

		Relative severity (%)		
D2a. The next 50 years, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; OR **D2b.** Any 50-year period including the past, present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 80	≥ 50	≥ 30
	≥ 80	CR	EN	VU
	≥ 50	EN	VU	
	≥ 30	VU		

		Relative severity (%)		
	Extent (%)	≥ 90	≥ 70	≥ 50
D3. Since 1750 based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
	≥ 70	EN	VU	
	≥ 50	VU		

E.The probability of ecosystem collapse according to a quantitative risk analysis:

CR	≥ 50% within 50 years
EN	≥ 20% within 50 years
VU	≥ 10% within 100 years

Appendix 2: Results of the assessment of threatened habitat types in Finland

Results of the assessment of threatened habitat types by region (F = whole Finland, SF = Southern Finland, NF = Northern Finland): IUCN Red List categories and their ranges, criteria, trend, category in the previous assessment and reasons for change of category. Reasons for habitat types becoming threatened and threat factors are given only for the whole of Finland and not subregion-specifically.

Trend: + improving, = stable, – declining, ? unknown. Reasons for change of category: 1 genuine change (marked* if the change is related to the changed time period of the assessment), 2 increased knowledge, 3 change in method, 4 new habitat type, 5 change in classification. A key to the abbreviations used for the reasons for becoming threatened and threat factors can be found in section 2.6.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
I	**The Baltic Sea**									
I1	**Hard benthic habitats characterized by perennial algae or aquatic moss**									
I1.01	Benthic habitats characterized by *Fucus*	F	EN	VU–CR	A2a, D1	–	VU	2, 3	WEP 3, WT 1	WEP 3, CC 2, WT 1, CHE 1
I1.02	Benthic habitats characterized by red algae	F	EN		A1	–	EN		WEP 3	WEP 3, CC 2
I1.03	Benthic habitats characterized by perennial filamentous algae	F	LC			?		4		
I1.04	Benthic habitats characterized by aquatic moss	F	LC			=	DD	2		WEP 2
I2	**Soft benthic habitats characterized by vegetation**									
I2.01	Benthic habitats characterized by *Hippuris*	F	DD		A1–A3, D1–D3	?		4		WEP 3, OGR 2
I2.02	Benthic habitats characterized by *Potamogeton* and/or *Stuckenia pectinata*	F	LC			=		4		WEP 2, WT 1
I2.03	Benthic habitats characterized by *Ranunculus*	F	NT	NT–VU	A1	–		4	WEP 3, WHC 1, WT 1	WEP 3, WHC 1, WT 1
I2.04	Benthic habitats characterized by *Zannichellia* and/or *Ruppia*	F	NT	NT–VU	A1	–		4	WEP 3, WT 1	WEP 3, WT 1
I2.05	Benthic habitats characterized by *Myriophyllum spicatum* and/or *M. sibiricum*	F	LC			+		4		
I2.06	Benthic habitats characterized by Charales									
I2.06.01	Exposed benthic habitats characterized by Charales	F	NT		A1	=	EN[1]	5	WEP 3, WT 2, WHC 2	WEP 3, WT 2, WHC 2
I2.06.02	Sheltered benthic habitats characterized by Charales	F	VU		A1	–	EN[1]	3	WEP 3, WT 2, WHC 2	WEP 3, WT 2, WHC 2
I2.07	Benthic habitats characterized by *Najas marina*	F	NT	LC–NT	A1	–		4	WEP 3, WHC 2, OGR 2, WT 1	WEP 3, WHC 2, OGR 2, WT 1
I2.08	Benthic habitats characterized by *Zostera marina*	F	VU		A1, B1,2a(ii,iii)b	–	EN	3	WEP 3, WHC 1, WT 1	WEP 3, CC 2, WHC 1, WT 1, CHE 1, OTF 1
I2.09	Benthic habitats characterized by *Eleocharis*	F	LC			=		4		WEP 2, OGR 2
I2.10	Benthic habitats characterized by floating-leaved plants	F	LC			=		4		WHC 2, WEP 2
I3	**Benthic habitats characterized by unattached vegetation**									
I3.01	Benthic habitats characterized by unattached *Fucus*	F	DD		A1–A3, B1–B3	?		4		WEP 3, WHC 2, CC 1
I3.02	Benthic habitats characterized by unattached *Ceratophyllum demersum*	F	LC			+		4		
I3.03	Benthic habitats characterized by unattached aggregations of *Aegagropila linnaei*	F	DD		A1–A3, B2	?		4		WEP 2
I4	**Hard benthic habitats characterized by invertebrates**									
I4.01	Benthic habitats characterized by *Mytilus*	F	LC			–	NT	3		CC 2, WEP 2, IAS 1, CHE 1
I4.02	Benthic habitats characterized by *Dreissena polymorpha*	F	NE					4		

[1]Benthic habitats characterized by Charales were assessed as one habitat type in 2008.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
14.03	Benthic habitats characterized by *Amphibalanus improvisus*	F	NE					4		
14.04	Benthic habitats characterized by hydroids (Hydrozoa)	F	DD		A1–A3, D1–D3	?		4		IAS 3, WEP 2
15	**Benthic habitats characterized by annual algae**									
15.01	Benthic habitats characterized by *Vaucheria*	F	LC			=		4		
15.02	Benthic habitats characterized by *Chorda filum* and/or *Halosiphon tomentosus*	F	LC			=		4		WEP 2
15.03	Benthic habitats characterized by filamentous annual algae	F	LC			+		4		
16	**Soft benthic habitats characterized by invertebrates**									
16.01	Benthic habitats characterized by *Mya arenaria*	F	DD		A1–A3, B1, B2, D1–D3	?		4		WEP 2, EXT 1
16.02	Benthic habitats characterized by *Macoma balthica*	F	LC			+		4		WEP 2
16.03	Benthic habitats characterized by *Cerastoderma*	F	DD		A1–A3, B1, B2, D1–D3	?		4		WEP 2
16.04	Benthic habitats characterized by Unionidae	F	EN	VU–EN	A3	?		4	WHC 3, CHE 3, WEP 2	WHC 3, CHE 3, WEP 2
16.05	Benthic habitats characterized by infaunal polychaetes	F	NE					4		
16.06	Benthic habitats characterized by *Monoporeia affinis* and/or *Pontoporeia femorata*	F	EN	EN–CR	A1	?		4	WEP 3, IAS 2	WEP 3, IAS 2
16.07	Benthic habitats characterized by *Bathyporeia pilosa*	F	DD		A1–A3, B1, B2, C1–C3, D1–D3	?		4		WEP 3, EXT 1
16.08	Benthic habitats characterized by midge larvae (Chironomidae)	F	LC			+		4		
16.09	Benthic habitats characterized by meiofauna	F	DD		B2, D1–D3	?		4		WEP 2
17	**Other benthic habitats**									
17.01	Benthic habitats characterized by microphytobenthic organisms and grazing snails	F	DD		A1–A3, B1–B3	?		4		
17.02	Benthic habitats characterized by anaerobic organisms	F	LC			+		4		
17.03	Benthic habitats characterized by globular colonies of cyanobacteria or ciliates	F	NE					4		
17.04	Benthic shell gravel habitats	F	DD		A1–A3, D1–D3	?		4		WEP 2, CC 1
17.05	Benthic habitats with ferromanganese concretion	F	DD		A3, C1–C3, D1–D3	?		4		WEP 2, EXT 1
18	**Pelagic habitats and sea ice**									
18.01	Pelagic habitats in the northern Baltic Proper and the Gulf of Finland	F	DD		B1, C1, D1	?		4		WEP 3, CC 2, IAS 2
18.02	Pelagic habitats in the Bothnian Sea and the Åland Sea	F	DD		B1, C1, D1	?		4		WEP 3, CC 2, IAS 2
18.03	Pelagic habitats in the Bothnian Bay	F	DD		B1, C1, D1	?		4		CC 3, WEP 2, IAS 1
18.04	Baltic Sea seasonal ice	F	VU	NT–VU	C1, C2a	–		4	CC 3, WT 1	CC 3, WT 1
19	**Baltic Sea habitat complexes**									
19.01	Fladas (coastal lagoons)	F	VU		CD3	–	VU		WHC 3, WEP 2, WT 1, CHE 1, OTF 1	WHC 3, WEP 2, WT 1, CHE 1, OTF 1
19.02	Glo-lakes (coastal lagoons)	F	VU		CD3	=	EN	3	WHC 3, WEP 2, CHE 1	WHC 3, WEP 2, CHE 1

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
19.03	Coastal estuaries	F	EN		CD3	?	EN		CHE 3, WHC 3, WEP 2, CST 2, DR 1, F 1, WT 1, WBR 1, OGR 1	CHE 3, WHC 3, WEP 2, CST 2, DR 1, F 1, WT 1, WBR 1, OGR 1
19.04	Reefs	F	NE					4		
19.05	Sand banks	F	NE					4		
R	**Baltic Sea coast**									
R1	**Coastal gravel, shingle and boulder shores**									
R1.01	Coastal stone and boulder shores	F	LC			=	LC			CST 1, CHE 1, WEP 1
R1.02	Coastal gravel and shingle shores	F	LC			=	LC			CHE 1, WEP 1, IAS 1
R2	**Coastal sand beaches and dunes**									
R2.01	Coastal sand beaches	F	EN		A1, A2a, A2b, CD1	–	EN		WEP 3, MW 3, CST 3, ADE 2, IAS 2, EXT 1	WEP 3, CC 3, MW 3, IAS 3, CST 3, ADE 2, WHC 2, WT 2
R2.02	Embryonic shifting dunes	F	EN		A1	–	EN		MW 3, WEP 2, ADE 2, CST 1, WT 1	MW 3, WEP 2, CC 2, ADE 2, CST 1
R2.03	Shifting dunes with *Leymus arenarius*	F	VU		B2a(i,ii,iii) b, CD1	–	VU		MW 3, ADE 2, IAS 2, WEP 2, CST 2, EXT 1	MW 3, IAS 3, ADE 2, WEP 2, CC 2, CST 1
R2.04	Fixed coastal dunes with herbaceous vegetation (grey dunes)	F	VU		A1, B2a(i,ii,iii) b, CD1	–	VU		MW 3, CST 3, ADE 2, EXT 1	MW 3, ADE 2, CC 2, CST 1, IAS 1
R2.05	Fixed coastal dunes with *Empetrum nigrum* (brown dunes)	F	CR		A2a, CD2a	–	VU	1	MW 3, CST 2, ADE 2, F 1, OGR 1	MW 3, ADE 2, CST 1, F 1, OGR 1, CC 1
R2.06	Humid dune slacks	F	EN		B2a(i,ii,iii)b	–	EN		DR 2, MW 2, OGR 2, ADE 2	OGR 2, ADE 2, DR 1
R2.07	Coastal wooded dunes	F	VU		A1, A2a, B2a(i,ii,iii) b, CD1	–	VU		F 3, CST 3, MW 2, EXT 1, ADE 1	F 3, CST 3, MW 2, ADE 1, EXT 1
R2.08	Dunes with deflation surfaces	F	CR		A2a, A3	–		4	OGR 3, ADE 2, CST 2	OGR 3, ADE 2, CST 1, CC 1
R3	**Coastal meadows**									
R3.01	Coastal stony meadows	F	NT	NT–VU	CD1, CD2a	–	NT		WEP 3, ADE 2, CST 1, OTF 1, WT 1	WEP 3, CC 3, ADE 2, CST 2, CHE 2, WT 1
R3.02	Coastal epilitoral meadows	F	VU	VU–EN	A2a, CD1	–		4	WEP 2, ADE 2, OGR 1, IAS 1	WEP 2, ADE 2, IAS 2, OGR 1
R3.03	Coastal tall-herb meadows	F	LC			=		4		
R4	**Coastal reedbeds**									
R4.01	Coastal reedbeds with *Phragmites australis*	F	LC			+	LC			
R4.02	Coastal reedbeds with *Schoenoplectus* and *Bolboschoenus maritimus*	F	NT	NT–VU	A1	–	DD	2	WEP 3, OGR 3	WEP 3, OGR 3, CHE 1
R4.03	Coastal reedbeds with *Typha*	F	LC			+		4		
R5	**Coastal drift lines with organic material**									
R5.01	Drift lines with *Fucus*	F	EN		CD1	–	VU	2, 3	WEP 3	WEP 3, CC 2, CHE 1, OTF 1, CST 1, IAS 1
R5.02	Drift lines with reed material	F	LC			+	LC			
R5.03	Drift lines with *Zostera marina*	F	EN		B1,2a(i,ii)b	–		4	WEP 3, OTF 1	WEP 3, CC 2, CHE 1, OTF 1
R6	**Coastal scrubs and forests**									
R6.01	Coastal scrub with *Hippophaë rhamnoides*	F	LC			=	LC			WEP 1, OTF 1, CC 1
R6.02	Coastal scrub with *Myrica gale*	F	VU		A1, A3	–	VU		OGR 3, WEP 2	OGR 3, WEP 2, CC 2
R6.03	Coastal *Salix* thickets	F	LC			=	LC			
R6.04	Coastal alder stands and scrub	F	LC			–	LC			CC 1, F 1, CST 1, WT 1, WHC 1
R6.05	Coastal *Juniperus communis* thickets	F	LC			+	LC			
R6.06	Deciduous-dominated forest stands in outer archipelago	F	LC			+		4		
R6.07	Coastal alder-dominated moist herb-rich forests	F	NT		A1, A3, CD1	–	NT		F 2, DR 2, WHC 2, AGCL 2, GP 1, WEP 1, FCWD 1	F 3, DR 2, WHC 2, CST 1, AGCL 1, WEP 1, FCWD 1
R6.08	Coastal mesic deciduous-dominated herb-rich forests	F	VU		A3, CD1	–	NT[2]	5, 3	F 2, AGCL 2, DR 1, WHC 1	F 2, CST 2, WHC 2, DR 1
R6.09	Coastal dry deciduous-dominated herb-rich forests	F	VU	VU–EN	B1,2a(i,ii,iii) b, CD1	–	NT[2]	5, 3	F 3, CST 3, OGR 1	CST 3, F 3, OGR 1

[2]In 2008 the habitat type was divided into two assessment units that had the same Red List category.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
R6.10	Coastal spruce-dominated herb-rich heath forests	F	EN		A3	–	EN		F 3, AGCL 2, CST 2, DR 2	F 3, DR 1, AGCL 1, CST 1
R6.11	Coastal deciduous-dominated herb-rich heath forests	F	VU	VU–EN	A1, CD1	–	VU		F 3, CST 3	F 3, CST 3
R6.12	Coastal spruce-dominated mesic heath forests	F	VU	VU–EN	A1, A3, CD1	=	EN	3, 2	F 3, AGCL 2, CST 1	F 3, CST 1, AGCL 1
R6.13	Coastal birch-dominated mesic heath forests	F	VU		CD1	–	NT	3, 2	F 3, CST 3, AGCL 1	F 3, CST 3, OGR 1
R6.14	Coastal spruce-dominated dry heath forests	F	EN		A3, B2a(ii,iii)b	=	EN		F 3, CST 1, ADE 1	F 3, ADE 2, CST 1
R6.15	Coastal pine-dominated dry heath forests	F	EN		A1	–	CR	3	F 3, CST 2, AGCL 1, ADE 1	F 3, ADE 2, CST 1
R6.16	Coastal birch-dominated dry heath forests	F	NT		A1	=	NT		F 3, CST 1, ADE 1	F 2, ADE 2, OGR 2
R6.17	Coastal spruce-dominated barren heath forests	F	EN		B2a(i,ii,iii)b	=	EN		F 3, ADE 1	ADE 2, F 1, CC 1
R6.18	Coastal pine-dominated barren heath forests	F	VU		A1, A3, CD3	–	VU		F 3, ADE 1	ADE 2, F 1
R6.19	Coastal birch-dominated barren heath forests	F	NT		A1	–	NT		OGR 3, ADE 2, F 1	OGR 3, ADE 2, F 1
R7	**Coastal rock pools**		NT	LC–NT	CD2a	=	NT		ADE 1, WEP 1	CC 2, ADE 1, WEP 1, CHE 1
R8	**Coastal habitat complexes**									
R8.01	Developmental series of coastal dunes	F	EN		B2a(i,ii,iii) b, CD1	–	EN		CST 3, WEP 3, F 3, MW 3, EXT 1, ADE 1, IAS 1	WEP 3, MW 3, F 3, IAS 2, CST 2, ADE 1, CC 1
R8.02	Natural forest succession series of the land uplift coast	F	EN		A1, A3	–	CR	3	F 3, CST 3, DR 2, AGCL 2, ADE 1	F 3, CST 2, CC 1, ADE 1, AGCL 1
R8.03	Barren islands succession series of the land uplift coast	F	NT		CD2a	–		4	ADE 2, WEP 1, OGR 1, IAS 1	ADE 2, WEP 2, IAS 2, CC 2
R8.04	Islands and islets in outer archipelago	F	LC			=	LC			CHE 1, WEP 1, IAS 1, CST 1
R8.05	Islets and cliffs with bird colonies	F	VU		CD1	–	NT	2, 3	IAS 3, OTF 3, ADE 2, WT 1, OGR 1, WEP 1	OTF 3, IAS 3, WT 3, ADE 2, WEP 1, CST 1, CC 1, OGR 1
R8.06	Baltic esker islands	F	EN	VU–EN	CD1	–	VU	2, 3	CST 3, F 3, WEP 2, EXT 1, MW 1, ADE 1, IAS 1	F 3, CST 3, WEP 3, IAS 2, ADE 1, EXT 1, MW 1
V	**Inlandwaters and shores**									
V1	**Lakes**									
V1.01	Small and medium-sized low-humic lakes	F	NT	LC–NT	D1	–	NT		WEP 2, DR 2, CST 1, CHE 1, WHC 1, WBR 1, F 1, ADE 1	WEP 2, DR 2, F 2, CC 2, CST 1, WHC 1, WBR 1, CHE 1, ADE 1, IAS 1
		SF	NT	LC–NT	D1	–	NT			
		NF	LC			–	NT	3, 2		
V1.02	Large low-humic lakes	F	NT	LC–VU	D2b	–	NT		WEP 2, WBR 2, WHC 1, CST 1, CHE 1, DR 1, ADE 1	WEP 2, WBR 2, WHC 1, CHE 1, CST 1, CC 1, ADE 1, IAS 1
		SF	NT	LC–VU	D2b	–	NT			
		NF	NT		B1a(ii,iii)b	–	LC	3, 2		
V1.03	Shallow low-humic lakes	F	NT	LC–VU	D3	–	NT		WEP 2, F 1, DR 1, CST 1, WHC 1, CHE 1, ADE 1	WEP 2, CC 2, DR 1, CST 1, WHC 1, ADE 1, F 1, IAS 1
		SF	NT	NT–VU	D1, D3	–	VU	3, 2		
		NF	LC			–	LC			
V1.04	Small humic lakes	F	NT		D1	=	NT		WEP 2, DR 2, WHC 1, CST 1, CHE 1, F 1	WEP 2, DR 2, WHC 1, CST 1, CC 1, F 1, IAS 1
		SF	NT		D1	=	NT			
		NF	LC			=	LC			
V1.05	Medium-sized humic lakes	F	LC			=	NT	3, 2	WEP 2, DR 1, WHC 1, CST 1, CHE 1, WBR 1, F 1	WEP 2, WBR 2, WHC 1, CST 1, DR 1, CC 1, F 1, IAS 1
		SF	LC			=	NT	3, 2		
		NF	VU		B1a(ii,iii)b, C3, D3	=	LC	3, 2		
V1.06	Large humic lakes	F	NT	LC–NT	D1	=	NT		WEP 2, WBR 2, WHC 1, CST 1, CHE 1	WEP 2, WBR 2, WHC 1, CST 1, CHE 1, CC 1, IAS 1
		SF	NT	LC–VU	D1	=	NT			
		NF	VU	NT–VU	D3	–	NT	3, 2		
V1.07	Shallow humic lakes	F	NT		C2b, D3	–	LC	3, 2	WEP 3, DR 1, CST 1, WHC 1, CHE 1, F 1	WEP 2, DR 1, CST 1, WHC 1, CC 1, IAS 1
		SF	VU		C1, C2b, D1	–	NT	3, 2		
		NF	LC			=	LC			
V1.08	Very humic lakes	F	LC			=	NT	3, 2		WEP 1, DR 1, CST 1, CC 1, IAS 1
		SF	LC			=	NT	3, 2		
		NF	LC			=	LC			

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V1.09	Shallow very humic lakes	F	NT		D3, CD3	=	NT		WEP 2, DR 1, F 1, CHE 1, WHC 1, CST 1	WEP 2, DR 1, WHC 1, CST 1, CC 1, F 1, IAS 1
		SF	NT		D3, CD3	=	NT			
		NF	LC			=	NT	3, 2		
V1.10	Subarctic lakes	F	NT		B1a(ii,iii)b	?	LC	3, 2	CC 1, CHE 1, WEP 1	CC 2, CHE 1, WEP 1, IAS 1
		SF								
		NF	NT		B1a(ii,iii)b	?	LC	3, 2		
V1.11	Naturally eutrophic lakes	F	EN	VU–EN	D1	–	EN		WEP 3, WBR 1, WHC 1, CST 1, CHE 1	WEP 3, WBR 2, CC 2, IAS 2, WHC 1, CST 1, CHE 1
		SF	EN		D1	–	EN			
		NF	NT		B1,2a(ii,iii)b	=	NT			
V1.12	Calcareous lakes	F	DD		A1–A3, B1, B2, C1–C3, D1–D3 , CD3	–	VU	5	WEP 2, WHC 1, CST 1, CHE 1	WEP 2, WHC 1, CST 1, CHE 1, IAS 1, CC 1
		SF	DD		A1–A3, B1–B3, C1–C3, D1–D3 , CD3	–	VU	5		
		NF	VU		B2a(ii,iii)b	–	NT	3, 5		
V1.13	Lakes with groundwater influence	F	DD		C1–C3, D1–D3, CD3	–		4		WEP 2, WHC 1, WBR 1, CST 1, GWA 1, CHE 1, DR 1, CC 1, F 1, IAS 1
		SF	DD		C1–C3, D1–D3, CD3	–		4		
		NF	DD		B1, B2, C1–C3, D1–D3, CD3	=		4		
V2	**Ponds and small lakes**									
V2.01	Esker ponds and small lakes	F	NT	LC–NT	C3	=	NT		CST 2, WEP 1, EXT 1, GWA 1, WHC 1, F 1, DR 1, CHE 1	CST 2, EXT 2, WEP 1, GWA 1, F 1, DR 1, IAS 1
		SF	NT	NT–VU	C3	–	VU	3		
		NF	LC			=	LC			
V2.02	Rocky ponds and small lakes	F	LC			=	LC			WEP 1, CST 1, F 1, CC 1
		SF	LC			=	LC			
		NF	LC			=	LC			
V2.03	Forest ponds and small lakes	F	NT		C3	=	LC	3	WEP 3, F 2, DR 2, CST 2, WHC 1, CHE 1	WEP 2, CST 2, F 2, DR 2, WHC 1
		SF	VU	NT–VU	C3	–	VU			
		NF	LC			=	LC			
V2.04	Mire ponds and small lakes	F	NT	NT–VU	C3	=	LC	3	WEP 3, DR 3, WHC 1, PE 1, F 1	WEP 2, DR 2, WHC 1, PE 1, F 1
		SF	VU	VU–EN	C3	–	NT	3		
		NF	LC			=	LC			
V2.05	Fell ponds and small lakes	F	LC			?	LC			CC 2, CHE 1, WEP 1
		SF								
		NF	LC			?	LC			
V2.06	Naturally eutrophic ponds and small lakes	F	EN	VU–EN	C3	–	CR	3	WEP 3, WHC 3, CST 1, CHE 1, F 1, DR 1	WEP 2, CST 2, WHC 1, F 1, DR 1, CC 1, IAS 1
		SF	EN	VU–EN	C3	–	CR	3		
		NF	DD		B1–B3, C3	=	NT	3		
V2.07	Calcareous ponds and small lakes	F	NT	LC–NT	C3	?	VU	3	WEP 3, WHC 2, CST 1, F 1, DR 1, CHE 1	WEP 2, CST 2, WHC 1, F 1, DR 1, IAS 1
		SF	VU	NT–VU	C3	?	EN	3		
		NF	VU		B2a(ii,iii)b	?	NT	3		
V2.08	Spring ponds and small lakes	F	DD		C3	=	NT	3		CST 2, WEP 1, GWA 1, EXT 1, WHC 1, F 1, DR 1, CC 1, IAS 1
		SF	DD		B2, C3	–	VU	3		
		NF	DD		B1, B2, C3	=	NT	3		
V2.09	Seasonal ponds	F	DD		A1–A3, B2, C3	–		4		DR 2, F 2, GWA 1, CC 1
		SF	DD		A1–A3, B2, C3	–		4		
		NF	DD		A1–A3, B2, C3	=		4		
V3	**Spring habitats**									
V3.01	Spring complexes	F	VU	NT–VU	CD3	=	VU	3	DR 3, F 3, WHC 2, CST 2, GWA 2, AGCL 1, EXT 1	DR 3, F 3, GWA 2, WHC 1, CC 1, CST 1, EXT 1, AGCL 1
		SF	EN	VU–EN	CD3	–	EN			
		NF	LC			=	LC			
V3.02	*Cratoneurion* spring complexes	F	NT	NT–VU	A3	–	VU	3	DR 3, F 3, AGCL 2, WHC 2, GWA 2, CST 1, EXT 1	DR 3, F 3, EXT 2, GWA 2, CC 1, WHC 1, CST 1, AGCL 1
		SF	EN	VU–EN	A3	–	EN			
		NF	LC			=	LC			

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V4	**Streams**									
V4.01	Streams in fell area									
V4.01.01	Intermittent streams in fell area	F	LC			?	LC			CC 2, CHE 1
		SF								
		NF	LC			?	LC			
V4.01.02	First order streams in fell area	F	LC			?	LC			CC 2, CHE 1
		SF								
		NF	LC			?	LC			
V4.01.03	Headwater streams in fell area	F	LC			?	LC			CC 2, CHE 1
		SF								
		NF	LC			?	LC			
V4.01.04	Streams and rivers in fell area	F	NT		B1a(ii,iii)b	?	LC	3, 2	CC 1, CHE 1	CC 2, CHE 1
		SF								
		NF	NT		B1a(ii,iii)b	?	LC	3, 2		
V4.01.05	Water falls in fell area	F	DD		B1, B2, C1–C3, D1–D3	?		4		CC 2, CHE 1
		SF								
		NF	DD		B1, B2, C1–C3, D1–D3	?		4		
V4.02	Streams of coniferous forest zone									
V4.02.01	Intermittent streams in coniferous forest zone	F	DD		A1–A3, C1–C3, D1–D3	–	DD			DR 3, F 2, WEP 1, CST 1, CC 1
		SF	DD		A1–A3, C1–C3, D1–D3	–	DD			
		NF	DD		A1–A3, C1–C3, D1–D3	–	LC	3		
V4.02.02	First order streams in coniferous forest zone	F	NT		C3	–	NT[3]		DR 3, F 2, WEP 2, CST 1, WHC 1, CHE 1	DR 3, F 2, WEP 2, CST 1, WHC 1, EXT 1, CHE 1, CC 1, IAS 1
		SF	VU		C3	–	VU[3]			
		NF	LC			–	LC[3]			
V4.02.03	First order streams in clay-dominated catchment areas	F	EN		C3	–	VU	3	WEP 3, DR 2, F 2, CST 1, CHE 1, WHC 1	WEP 2, DR 2, IAS 2, CST 1, F 1, WHC 1, CHE 1, CC 1
		SF	EN		C3	–	VU	3		
		NF								
V4.02.04	Headwater streams in coniferous forest zone	F	VU		C3	–	NT–VU	3, 5	DR 3, WEP 2, F 2, WHC 1, CST 1, CHE 1	DR 3, F 2, WEP 2, WHC 1, CST 1, EXT 1, CC 1, IAS 1, CHE 1
		SF	EN		C3	–	VU[3]	3, 5		
		NF	NT		C3	–	LC–NT	3, 5		
V4.02.05	Headwater streams in clay-dominated catchment areas	F	CR		C3	–	CR[3]		WEP 3, WHC 2, DR 2, F 2, CST 1, CHE 1	WEP 3, WHC 2, DR 2, CC 2, IAS 2, CST 1, CHE 1, F 1
		SF	CR		C3	–	CR[3]			
		NF								
V4.02.06	Large streams in coniferous forest zone	F	VU	LC–VU	D3	–	NT	3, 2	WHC 2, WEP 2, WBR 2, DR 2, F 1, CST 1, CHE 1	WEP 2, WHC 2, WBR 2, DR 2, F 1, CST 1, EXT 1, CHE 1, CC 1, IAS 1
		SF	VU		D3, CD3	–	VU			
		NF	LC			–	LC			
V4.02.07	Large streams in clay-dominated catchment areas	F	EN		C3	–	CR	3, 2	WEP 3, WHC 2, WBR 2, DR 2, CST 1, CHE 1, F 1	WEP 3, WHC 2, WBR 2, CC 2, IAS 2, DR 1, CST 1, CHE 1, F 1
		SF	EN		C3	–	CR	3, 2		
		NF								
V4.02.08	Rivers in coniferous forest zone	F	VU		C3	–	VU		WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1, CHE 1	WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1, CHE 1, CC 1, IAS 1
		SF	EN		C3	–	EN			
		NF	LC			–	NT	3, 2		
V4.02.09	Rivers in clay-dominated catchment areas	F	CR		C3	–	CR		WEP 3, WHC 3, WBR 2, DR 2, CST 1, CHE 1, F 1	WEP 3, WHC 3, WBR 2, CC 2, IAS 2, DR 1, CST 1, CHE 1, F 1
		SF	CR		C3	–	CR			
		NF								
V4.02.10	Large rivers	F	CR		C3	–	EN	3, 2	WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1	WHC 3, WEP 2, WBR 2, DR 1, F 1, CST 1, CC 1, IAS 1
		SF	CR		C3	–	CR			
		NF	CR		C3	–	VU	3, 2		
V4.02.11	Water falls in coniferous forest zone	F	DD		B2, C1–C3, D1–D3	–		4	WHC 3, WEP 2, DR 1	WEP 2, DR 1, CC 1
		SF	DD		B2, C1–C3, D1–D3	–		4		
		NF	DD		B1, B2, C1–C3, D1–D3	=		4		

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Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
V4.03	Meandering streams									
V4.03.01	Meandering headwater streams	F	DD		A1–A3, C1, C2a, D1, D2a	–		4		WEP 2, F 2, DR 1, CC 1, WHC 1, CHE 1, IAS 1
		SF	DD		A1–A3, C1, C2a, D1, D2a	–		4		
		NF	DD		A1–A3, C1, C2a, D1, D2a	=		4		
V4.03.02	Meandering streams and rivers	F	DD		A1–A3, C1, C2a, D1, D2a	–		4		WEP 2, DR 1, F 1, CC 1, WHC 1, IAS 1
		SF	DD		A1–A3, C1, C2a, D1, D2a	–		4		
		NF	DD		A1–A3, C1, C2a, D1, D2a	=		4		
V5	**Shores**									
V5.01	Stone and boulder lake shores	F	LC			=	LC			R 1, WEP 1, WBR 1, WHC 1, IAS 1
		SF	LC			=	LC			
		NF	LC			=	LC			
V5.02	Gravel and shingle lake shores	F	DD		A1–A3, CD1–CD3	–		4		WEP 2, CST 2, WBR 1, WHC 1, OGR 1, IAS 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD2a	=		4		
V5.03	Sand and fine sand lake shores	F	VU		A1	–	VU		CST 3, WEP 2, WHC 2, WBR 2, MW 1, OGR 1, IAS 1, ADE 1	CST 2, WEP 2, WBR 2, CC 2, WHC 1, MW 1, OGR 1, ADE 1, IAS 1
		SF	EN		A1	–	EN			
		NF	NT	LC–NT	A1	=	NT			
V5.04	Erosion banks on lake shores	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, WHC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.05	Clay and silt lake shores	F	DD		A1–A3, CD1–CD3	–		4		WEP 2, OGR 2, CC 2, CST 1, WBR 1, WHC 1, IAS 1, CHE 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, B1, B2, CD1–CD3	=		4		
V5.06	Mixed lake shores	F	LC			=		4		CST 1, WEP 1, WHC 1, WBR 1, IAS 1
		SF	LC			=		4		
		NF	LC			=		4		
V5.07	Mud and gyttja lake shores	F	DD		A1–A3, CD1–CD3	=		4		CST 1, WBR 1, WHC 1, OGR 1, IAS 1, WEP 1, CC 1
		SF	DD		A1–A3, CD1–CD3	=		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.08	Lake shore scrubs	F	LC			=	LC			CST 1, IAS 1, DR 1, WEP 1, WHC 1, CC 1
		SF	LC			–	LC			
		NF	LC			=	LC			
V5.09	Tall-helophyte beds of lake and river shores	F	LC			=		4		CST 1, WEP 1, WBR 1, WHC 1, IAS 1, CC 1
		SF	LC			=		4		
		NF	LC			=		4		

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V5.10	Tall-sedge beds of lake and river shores	F	DD		A1–A3, CD1–CD3	–		4		OGR 3, WEP 2, IAS 2, WHC 1, CST 1, DR 1, WBR 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD2a	=		4		
V5.11	Stone and boulder river shores	F	DD		CD1–CD3	=		4		WBR 2, WEP 1, WHC 1, IAS 1
		SF	DD		CD1–CD3	=		4		
		NF	DD		CD1–CD3	=		4		
V5.12	Gravel and shingle river shores	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, OGR 1, CST 1, WEP 1, WHC 1, IAS 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.13	Sand and fine sand shores and sandbanks of rivers	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, OGR 1, CST 1, WEP 1, WHC 1, MW 1, IAS 1, CC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.14	Erosion banks on river shores	F	DD		A1–A3, CD1–CD3	–		4		WBR 2, WHC 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.15	Clay and silt river shores	F	DD		A1–A3, CD1–CD3	–		4		WEP 2, CC 2, WBR 1, WHC 1, OGR 1, CST 1, IAS 1, CHE 1
		SF	DD		A1–A3, CD1–CD3	–		4		
		NF	DD		A1–A3, CD1–CD3	=		4		
V5.16	Mixed river shores	F	LC			=		4		WEP 1, WBR 1, WHC 1, CST 1, IAS 1
		SF	LC			=		4		
		NF	LC			=		4		
V5.17	River shore scrubs	F	LC			=		4		CST 1, IAS 1, WBR 1, WHC 1, DR 1, CC 1
		SF	LC			=		4		
		NF	LC			=		4		
S	**Mires**									
S01	**Spruce mires**									
S01.01	Thin-peated spruce mires	F	EN		A1, A3	–	VU	3, 1	DR 3, F 3, AGCL 2, CST 1, WHC 1	F 3, DR 2, CST 1, WHC 1, AGCL 1
		SF	CR		A3	–	VU	3, 1		
		NF	VU		A1, A3	–	LC	3, 1		
S01.02	Thin-peated rich spruce mires	F	VU	VU–EN	A1, A3	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1	DR 2, F 2, CST 1, WHC 1, AGCL 1
		SF	EN	EN–CR	A1, A3	–	EN			
		NF	VU		A1	–	NT	3		
S01.03	Herb-rich spruce mires	F	VU	VU–EN	A3	–	VU		DR 3, AGCL 3, F 2, WHC 2, CST 1, PE 1	DR 2, F 2, CST 1, WHC 1, PE 1, AGCL 1, IAS 1
		SF	EN	EN–CR	A3	–	EN			
		NF	NT		A1, A3	–	NT			
S01.04	Dwarf-shrub spruce mires	F	EN		A1, A3	–	VU	3, 1	DR 3, F 3, AGCL 1, WHC 1, CST 1, PE 1	F 3, DR 2, CST 1, WHC 1, PE 1, AGCL 1
		SF	EN		A1, A3	–	VU	3, 1		
		NF	VU		A1	–	NT	3, 1		
S01.04.01	*Vaccinium* spruce mires	F	EN		A1, A3	–	VU[4]	3, 1	DR 3, F 3, AGCL 1, WHC 1, CST 1	F 3, DR 2, CST 1, WHC 1, AGCL 1
		SF	EN		A1, A3	–	VU[4]	3, 1		
		NF	VU		A1	–	NT[4]	3, 1		
S01.04.02	*Equisetum sylvaticum* spruce mires	F	EN		A1, A3	–	EN		DR 3, F 3, AGCL 1, WHC 1, CST 1	F 3, DR 2, CST 1, WHC 1, AGCL 1
		SF	EN		A1, A3	–	EN			
		NF	VU		A1	–	VU			
S01.04.03	*Rubus chamaemorus* spruce mires	F	EN		A1, A3	–	VU	3	DR 3, F 3, AGCL 1, WHC 1, CST 1, PE 1	F 3, DR 2, CST 1, WHC 1, PE 1, AGCL 1
		SF	EN		A1, A3	–	VU	3		
		NF	NT		A1, A3	–	NT			

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S02	**Spruce-birch fens and rich spruce-birch fens**									
S02.01	Rich spruce-birch fens	F	VU	VU–EN	A1, A3	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1, OGR 1	DR 3, F 2, OGR 1, CST 1, WHC 1, EXT 1, GWA 1
		SF	CR		A3	–	CR			
		NF	VU		A1, A3	?	VU			
S02.02	Tall-sedge spruce-birch fens	F	VU		A1, A3	–	NT	3	DR 3, F 2, AGCL 2, WHC 1, CST 1, PE 1	DR 2, F 1, WHC 1, PE 1, AGCL 1
		SF	EN		A1, A3	–	VU	3		
		NF	NT		A1	=	NT			
S02.03	*Carex nigra* birch fens	F	EN		A1, A3	–	EN		DR 3, F 2, AGCL 1, CST 1	DR 2, F 1, WHC 1
		SF	EN		A1, A3	–	EN			
		NF								
S02.04	*Eriophorum vaginatum* birch fen	F	VU	NT–VU	A1, A3	–	EN	2, 1*	DR 3, F 2, AGCL 1, PE 1, CST 1	DR 2, F 1, WHC 1, PE 1, AGCL 1
		SF	VU	VU–EN	A1, A3	–	EN	2, 1*		
		NF	LC	LC–NT		=	NT	3		
S03	**Pine mires and bogs**									
S03.01	Thin-peated pine mires	F	VU	VU–EN	A1, A3	–	NT	3, 1	DR 3, F 3, AGCL 1, CST 1	F 3, DR 2, CST 1, AGCL 1
		SF	EN		A1, A3	–	NT	3, 1		
		NF	NT		A1, A3	–	LC	3, 1		
S03.02	Spruce-pine mires	F	EN		A1	–	VU	3	DR 3, F 2, AGCL 1, CST 1	F 2, DR 2, AGCL 1
		SF	EN		A1, A3	–	VU	3		
		NF	NT		A1, A3	=	NT			
S03.03	*Carex* globularis pine mires	F	NT		A1, A3	–	NT		DR 3, F 2, AGCL 1, CST 1	DR 2, F 1, AGCL 1
		SF	VU		A1, A3	–	VU			
		NF	LC			=	LC			
S03.04	Dwarf-shrub pine bogs and mires	F	NT	NT–VU	A1, A3	=	LC	3	DR 3, F 2, PE 2, CST 1	F 2, DR 1, PE 1
		SF	VU	VU–EN	A1, A3	=	NT	3		
		NF	LC			=	LC			
S03.05	*Eriophorum vaginatum* pine bogs and mires	F	NT	NT–VU	A1, A3	=	LC	3	DR 3, F 2, PE 2, CST 1, AGCL 1	PE 2, DR 1, F 1, AGCL 1, OTF 1
		SF	VU	VU–EN	A1, A3	=	NT	3		
		NF	LC			=	LC			
S03.06	*Sphagnum fuscum* bogs	F	LC			=	LC			PE 1, OTF 1
		SF	LC			=	LC			
		NF	LC			=	LC			
S03.07	Frost bogs and mires	F	DD		A1–A3, CD1–CD3	–	NT	3		CC 3, GP 1
		SF								
		NF	DD		A1–A3, CD1–CD3	–	NT	3		
S03.07.01	Palsa bogs	F	EN	EN–CR	A2a, E	–		4	CC 2, GP 1	CC 3, GP 1
		SF								
		NF	EN	EN–CR	A2a, E	–		4		
S03.07.02	Pounikkos	F	DD		A1–A3, CD1–CD3	–		4		CC 3, GP 1
		SF								
		NF	DD		A1–A3, CD1–CD3	–		4		
S04	**Pine fens and rich pine fens**									
S04.01	Rich pine fens	F	VU		A1, A3	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1, OGR 1	DR 3, OGR 2, F 1, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1
		SF	CR		A3	–	CR			
		NF	VU		A1	–	VU			
S04.01.01	Mire margin influenced rich pine fens	F	VU		A1, A3	–		4	DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1, OGR 1	DR 3, OGR 2, F 1, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1
		SF	CR		A3	–		4		
		NF	VU		A1	–		4		
S04.01.02	Rich pine fens with *Sphagnum fuscum*	F	NT		A1, A3	–		4	DR 3, AGCL 2, F 2, WHC 1, CST 1, GWA 1	DR 3, F 1, OGR 1, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1
		SF	CR		A3	–		4		
		NF	NT		A1	–		4		
S04.02	Moderately rich pine fens	F	VU	NT–VU	A1	–	VU		DR 3, AGCL 3, F 2, WHC 1, CST 1, GWA 1	DR 3, F 1, CST 1, WHC 1, GWA 1, AGCL 1, PE 1
		SF	CR		A3	–	CR			
		NF	NT		A1	=	VU	3		
S04.03	Tall-sedge pine fens	F	VU	NT–VU	A3	–	LC	3	DR 3, F 2, AGCL 2, PE 2, CST 1	DR 2, F 1, PE 1, AGCL 1
		SF	EN		A3	–	VU	3		
		NF	LC			=	LC			
S04.04	*Sphagnum papillosum* pine fens	F	NT	NT–VU	A1, A3	=	VU	5	DR 3, PE 2, F 1, AGCL 1, CST 1	DR 1, F 1, PE 1, AGCL 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	NT	5		

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S04.05	Flark pine fens	F	LC	LC–NT		–	LC		DR 3, PE 1, F 1, AGCL 1, WHC 1, CST 1	DR 2, PE 1, WHC 1, CC 1
		SF	EN	VU–EN	C1	–	NT	3, 2, 1		
		NF	LC			=	LC			
S04.06	Low-sedge pine fens	F	NT		A1, A3	=	NT		DR 3, F 1, AGCL 1, PE 1, CST 1	DR 1, F 1, PE 1, AGCL 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	NT	3, 1*		
S04.07	Ridge-hollow pine bogs	F	LC	LC–NT		=	LC		DR 2, PE 2, AGCL 1, CST 1, ADE 1	PE 1, ADE 1
		SF	NT		A1	–	LC	3		
		NF	LC			=	LC			
S05	**Fens**									
S05.01	Moderately rich fens	F	VU		A1, A3	–	VU		DR 3, AGCL 3, PE 1, CST 1, WHC 1, GWA 1	DR 3, OGR 2, CST 1, WHC 1, EXT 1, GWA 1, AGCL 1, PE 1
		SF	CR		A3	–	CR			
		NF	NT	NT–VU	A1, A3	=	NT			
S05.02	Swamp fens	F	NT		A1, A3	–	LC	3	DR 3, WHC 2, WBR 2, AGCL 2, CST 1, OGR 1	DR 2, WBR 2, WHC 1, CST 1, OGR 1
		SF	VU		A3	–	NT	3		
		NF	LC			=	LC			
S05.03	Tall-sedge fens	F	NT	NT–VU	A1, A3	–	LC	3	DR 3, AGCL 3, PE 2, CST 1, WHC 1	DR 2, PE 1, CST 1
		SF	VU		A1, A3	–	VU			
		NF	LC			=	LC			
S05.04	*Sphagnum papillosum* low-sedge fens	F	NT	NT–VU	A1, A3	=	NT		DR 3, PE 2, AGCL 1, CST 1	DR 1, PE 1, CST 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	LC			
S05.05	Flark fens	F	LC			–	LC		DR 3, AGCL 1, WHC 1, PE 1, CST 1	DR 2, PE 1, CST 1, CC 1
		SF	EN	VU–EN	C1	–	NT	3, 1		
		NF	LC			=	LC			
S05.06	Minerotrophic low-sedge fens	F	NT		A1, A3	=	LC	3	DR 3, AGCL 1, PE 1, CST 1	DR 1, PE 1, CST 1, OTF 1
		SF	VU		A1, A3	=	VU			
		NF	LC			=	LC			
S05.07	Hollow bogs	F	LC			=	LC			PE 1, ADE 1
		SF	LC			–	NT	3		
		NF	LC			=	LC			
S05.08	Ombrotrophic low-sedge bogs	F	LC	LC–NT		=	LC			DR 1, PE 1, ADE 1, OTF 1
		SF	LC	LC–NT		=	NT	1*		
		NF	LC			=	LC			
S06	**Rich fens**									
S06.01	Rich swamp fens	F	DD		A1–A3, CD1–CD3	–	EN	3	DR 3, AGCL 3, CST 2, WHC 2, WBR 2, OGR 1	DR 2, OGR 2, CST 1, WHC 1, WBR 1, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	DD		A1–A3, B1, B2, CD1–CD3	=	EN	3		
S06.02	Rich spring fens	F	VU		A1	–	VU		DR 3, F 3, GWA 2, AGCL 1, CST 1, EXT 1	GWA 3, DR 2, F 1, CST 1, EXT 1
		SF	CR		A3	–	CR			
		NF	NT		A1	=	NT			
S06.03	Rich birch fens	F	EN	EN–CR	A3	–	VU	3	AGCL 3, DR 3, WHC 1, PE 1, GWA 1, CST 1, F 1, EXT 1, OGR 1	DR 3, GWA 2, EXT 2, CST 1, OGR 1, WHC 1, AGCL 1, CC 1
		SF	CR		A3	–	CR			
		NF	VU		A1, A3	–	NT	3		
S06.03.01	Rich birch flark fens	F	EN		A3	–	VU	3	DR 3, AGCL 2, WHC 1, PE 1, GWA 1, EXT 1, CST 1	DR 3, EXT 2, GWA 1, CST 1, WHC 1, AGCL 1, CC 1
		SF	CR		A3	–	CR			
		NF	VU		A1, A3	–	NT	3		
S06.03.02	Rich birch lawn fens	F	CR		A3	–	CR		AGCL 3, DR 3, WHC 1, PE 1, GWA 1, CST 1, F 1, EXT 1, OGR 1	DR 3, GWA 2, EXT 2, OGR 1, CST 1, WHC 1, AGCL 1
		SF	CR		A3	–	CR			
		NF	EN		A1, A3	–	EN			
S06.04	Rich lawn fens	F	EN	EN–CR	A1, A3	–	EN		AGCL 3, DR 3, OGR 2, WHC 1, PE 1, CST 1, GWA 1, EXT 1	DR 3, OGR 2, GWA 2, EXT 1, WHC 1, CST 1
		SF	CR		A3	–	CR			
		NF	EN		A1, A3	–	EN			
S06.05	Rich flark fens	F	VU		A1, A3	–	NT	3, 1	DR 3, AGCL 2, WHC 1, PE 1, CST 1	DR 3, CST 1, WHC 1, CC 1
		SF	CR		A3	–	CR			
		NF	NT	NT–VU	A1, A3	=	NT			
S06.06	Calcareous fens	F	CR		A3	–		4	AGCL 3, DR 3, OGR 2, CST 1, EXT 1	DR 3, OGR 2, EXT 1, GWA 1, WHC 1, CST 1
		SF	CR		A3	–		4		
		NF	EN		A3	=		4		
S06.07	Rich *Calliergon richardsonii* flark fens	F	VU		B1b	?		4	DR 1, AGCL 1, WHC 1, CST 1	DR 2, EXT 2, CST 1, WHC 1, CC 1
		SF								
		NF	VU		B1b	?		4		

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S07	**Swamps**									
S07.01	Wooded swamps	F	DD		A1–A3, CD1–CD3	–	VU	3	WHC 3, WBR 3, DR 3, AGCL 2, CST 2, F 2, GWA 1	DR 2, WBR 2, F 2, WHC 1, CST 1, AGCL 1, GWA 1
		SF	DD		A1–A3, CD1–CD3	–	VU	3		
		NF	DD		A3, CD1–CD3	=	LC	3		
S07.01.01	Birch swamps	F	DD		A1–A3, CD1–CD3	–	NT	3	WHC 3, WBR 3, DR 3, AGCL 2, CST 2, F 2	DR 2, WBR 2, F 2, WHC 1, CST 1, AGCL 1
		SF	DD		A1–A3, CD1–CD3	–	VU	3		
		NF	DD		A3, CD1–CD3	=	LC	3		
S07.01.02	Black alder swamps	F	EN	EN–CR	A3	–	VU	3	WHC 3, WBR 3, DR 3, AGCL 2, CST 2, F 1, GWA 1	DR 2, CST 2, GWA 2, WBR 1, F 1, WHC 1, IAS 1
		SF	EN	EN–CR	A3	–	VU	3		
		NF								
S07.01.03	Grey alder swamps	F	EN	EN–CR	A1	–	CR	3	DR 3, AGCL 3, CST 2, WHC 1, F 1	DR 2, CST 2, F 1, WHC 1, AGCL 1
		SF	EN	EN–CR	A1	–	CR	3		
		NF								
S07.02	Shrub swamps	F	LC			–	LC			DR 2, WBR 2, CST 1, WHC 1, IAS 1
		SF	LC			–	NT	3		
		NF	LC			=	LC			
S07.02.01	*Salix* swamps	F	LC			–	NT	3		DR 2, WBR 2, CST 1, WHC 1, IAS 1
		SF	LC			–	NT	3		
		NF	LC			=	LC			
S07.02.02	Northern *Salix* swamps	F	LC			=	LC			
		SF								
		NF	LC			=	LC			
S07.02.03	*Myrica gale* swamps	F	VU	NT–VU	A1	–	EN	3	DR 2, CST 2, WHC 1, WBR 1	DR 2, CST 2, WHC 1, AGCL 1, OGR 1
		SF	VU	NT–VU	A1	–	EN	3		
		NF								
S07.03	Open swamps	F	LC			–	LC			DR 2, WBR 2, OGR 2, WEP 2, WHC 1, CST 1, IAS 1
		SF	DD		CD1–CD3	–	NT	3		
		NF	LC			=	LC			
S08	**Low-productive seasonal wetlands**	F	DD		A1–A3, CD1–CD3	–	DD			DR 2, EXT 1, GWA 1, F 1, CST 1, AGCL 1
		SF	DD		A1–A3, CD1–CD3	–	DD			
		NF	DD		A1–A3, CD1–CD3	?	DD			
S09	**Mire complexes**									
S09.01	Raised bogs									
S09.01.01	Ridge-hollow raised bogs									
S09.01.01.01	Plateau and heath raised bogs	F	VU		B1,2a(ii,iii)	–	NT	3, 2	DR 2, AGCL 1, F 1, PE 1, ADE 1	DR 1, F 1, ADE 1
		SF	VU		B1,2a(ii,iii)	–	NT	3, 2		
		NF								
S09.01.01.02	Concentric raised bogs	F	VU	VU–EN	CD3	–	NT	3	DR 2, PE 2, AGCL 1, F 1, CST 1, ADE 1	DR 2, PE 1, F 1, OTF 1, ADE 1
		SF	VU	VU–EN	CD3	–	NT	3		
		NF								
S09.01.01.03	Eccentric raised bogs	F	NT	NT–VU	CD3	–	VU	3	DR 3, PE 2, AGCL 1, F 1, CST 1, ADE 1	PE 2, DR 2, F 1, OTF 1, ADE 1
		SF	VU		CD3	–	VU			
		NF	LC			=	LC			
S09.01.01.04	Northern reticulate raised bogs	F	LC			=	LC			CC 1
		SF								
		NF	LC			=	LC			
S09.01.02	Wooded and *Sphagnum fuscum* raised bogs									
S09.01.02.01	Wooded raised bogs	F	VU		CD3	–	EN	3	DR 3, F 2, PE 1, CST 1	F 2, DR 2
		SF	VU		CD3	–	EN	3		
		NF								
S09.01.02.02	*Sphagnum fuscum* raised bogs	F	NT	NT–VU	CD3	=	VU	3	DR 2, PE 2, CST 1, AGCL 1, ADE 1	PE 2, DR 1, ADE 1, OTF 1
		SF	VU		CD3	=	VU			
		NF	LC			=	LC			

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
S09.02	Aapa mires									
S09.02.01	Middle boreal aapa mires	F	EN	VU–EN	CD3	–	EN		DR 3, AGCL 2, PE 2, F 1, CST 1, WHC 1, GWA 1, OGR 1	DR 3, PE 2, F 2, CC 2, AGCL 1, GWA 1, OTF 1, OGR 1
		SF	EN	VU–EN	CD3	–	EN			
		NF					NT	5		
S09.02.02	Northern boreal aapa mires									
S09.02.02.01	Southern subtype of northern boreal aapa mires	F	NT	LC–NT	CD3	–	LC	3	DR 2, AGCL 2, PE 1, F 1, CST 1, WHC 1, GWA 1, OGR 1	DR 2, PE 1, F 1, WHC 1, EXT 1, CC 1
		SF								
		NF	NT	LC–NT	CD3	–	LC	3		
S09.02.02.02	Northern subtype of northern boreal aapa mires	F	LC			=	LC			CC 1
		SF								
		NF	LC			=	LC			
S09.03	Southern fen complexes	F	CR		A3	–		4	AGCL 3, DR 2, PE 1, CST 1, GWA 1, WHC 1, OGR 1	DR 2
		SF	CR		A3	–		4		
		NF								
S09.04	Sloping fens									
S09.04.01	Middle boreal sloping fens	F	VU		B1,2a(i,ii,iii)b	–	VU		DR 2, F 2, CST 1	F 2, DR 2, CST 1
		SF	VU		B1,2a(i,ii,iii)b	–	VU			
		NF								
S09.04.02	Northern boreal sloping fens	F	LC			–	LC			F 1, DR 1, CST 1, MW 1
		SF								
		NF	LC			–	LC			
S09.05	Palsa mires	F	VU		B1a(ii,iii)b, CD3	–	NT	3, 2	CC 2, MW 1, GP 1	CC 3, MW 1, GP 1
		SF								
		NF	VU		B1a(ii,iii)b, CD3	–	NT	3, 2		
S09.06	Fell mires	F	LC			?	LC			CC 1, GP 1, MW 1
		SF								
		NF	LC			?	LC			
S09.07	Coastal mires	F	EN		A3	–		4	DR 3, F 3, AGCL 2, CST 2, OGR 1, WHC 1	F 3, DR 3, CST 2, AGCL 1, OGR 1, OTF 1
		SF	EN		A3	–		4		
		NF								
S09.08	Local mire complexes	F	VU	VU–EN	A1, A3	–	DD	2	DR 3, F 3, AGCL 2, CST 2, GWA 1, OGR 1, WHC 1, WBR 1, EXT 1	F 3, DR 3, AGCL 1, CST 1, GWA 1, OGR 1, WHC 1, WBR 1, EXT 1
		SF	EN	VU–EN	A1, A3	–	DD	2		
		NF	LC			–	DD	2		
S10	**Mire succession series of land uplift coast**									
S10.01	Raised bog succession series of land uplift coast	F	CR	EN–CR	A1, A3	–	CR		DR 3, AGCL 3, F 3, CST 2, OGR 1, WHC 1	DR 3, F 3, CST 2, AGCL 1, OGR 1
		SF	CR	EN–CR	A1, A3	–	CR			
		NF								
S10.02	Aapa mire succession series of land uplift coast	F	CR	EN–CR	A1, A3	–	CR		DR 3, AGCL 3, F 3, CST 2, OGR 1, WHC 1	DR 3, F 3, CST 2, AGCL 1, OGR 1
		SF	CR	EN–CR	A1, A3	–	CR			
		NF								
S10.03	Succession series of small mires on land uplift coast	F	EN		A1, A3	–		4	DR 3, F 3, AGCL 2, CST 2, OGR 1, WHC 1	DR 3, F 3, CST 2, AGCL 1, OGR 1
		SF	EN		A1, A3	–		4		
		NF								
M	**Forests**									
M1	**Herb-rich forests**	F	VU		CD1	–	VU		AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, DR 1, FDS 1, CST 1, WHC 1, IAS 1, WBR 1, EXT 1, MW 1, GP 1	FTS 3, FCWD 2, FOG 2, F 1, IAS 1, DR 1, FDS 1, GP 1, CST 1, WBR 1, EXT 1 ,OTF 1, MW 1
		SF	VU		CD1	–	VU			
		NF	NT		CD1	=	NT			
M1.01	Herb-rich forests with deciduous (hardwood) trees	F	VU		A1	=	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, OTF 2, F 1, GP 1, CST 1, DR 1, FDS 1, IAS 1, MW 1, WBR 1, WHC 1	FTS 2, FCWD 2, FOG 2, OTF 2, GP 1, F 1, FDS 1, CST 1, IAS 1, DR 1, MW 1, WBR 1
		SF	VU		A1	=	EN	3		
		NF								
M1.01.01	Herb-rich forests with small-leaved lime	F	VU		A1	=	EN	3	AGCL 3, FTS 3, FOG 2, FCWD 2, F 1, GP 1, FDS 1, CST 1, IAS 1, OTF 1	FTS 2, FCWD 2, FOG 2, GP 1, F 1, FDS 1, CST 1, IAS 1, OTF 1
		SF	VU		A1	=	EN	3		
		NF								

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
M1.01.02	Herb-rich forests with hazel	F	VU		A1	=	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, FDS 1, GP 1, CST 1, MW 1, IAS 1	FTS 2, FCWD 2, FOG 2, GP 1, F 1, FDS 1, CST 1, IAS 1
		SF	VU		A1	=	EN	3		
		NF								
M1.01.03	Herb-rich forests with common oak	F	VU		A3	=	CR	3	AGCL 3, FTS 3, FCWD 2, FOG 2, GP 2, F 1, FDS 1, CST 1, OTF 1, MW 1	FTS 2, FCWD 2, FOG 2, GP 2, OTF 1, F 1, FDS 1, CST 1, MW 1, IAS 1
		SF	VU		A3	=	CR	3		
		NF								
M1.01.04	Herb-rich forests with common ash	F	VU		A1, B1a(i,iii)b	–	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, OTF 2, DR 2, F 1, FDS 1, GP 1, CST 1	OTF 3, FTS 2, FCWD 2, FOG 2, DR 2, GP 1, FDS 1, F 1, IAS 1, CST 1
		SF	VU		A1, B1a(i,iii)b	–	EN	3		
		NF								
M1.01.05	Herb-rich forests with Norway maple	F	NT		A1	=	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, GP 1, FDS 1, CST 1, MW 1	FTS 2, FCWD 2, FOG 2, F 1, MW 1, GP 1, FDS 1, CST 1, IAS 1
		SF	NT		A1	=	EN	3		
		NF								
M1.01.06	Herb-rich forests with wych elm	F	VU		A1, B1,2a(i,ii)b	–	CR	3	AGCL 3, FTS 3, FCWD 2, FOG 2, OTF 2, F 1, GP 1, FDS 1, CST 1	OTF 3, FTS 2, FCWD 2, FOG 2, GP 1, F 1, FDS 1, IAS 1, CST 1
		SF	VU		A1, B1,2a(i,ii)b	–	CR	3		
		NF								
M1.01.07	Herb-rich forests with European white elm	F	EN		A1, B1,2a(i,ii,iii)bc	–	CR	3	AGCL 3, FTS 3, WBR 3, WHC 2, FCWD 2, FOG 2, OTF 2, DR 2, CST 1, F 1, FDS 1, GP 1, IAS 1	OTF 3, WBR 2, FTS 2, FCWD 2, FOG 2, IAS 1, FDS 1, F 1, GP 1, CST 1, RTF 1
		SF	EN		A1, B1,2a(i,ii,iii)bc	–	CR	3		
		NF								
M1.02	Herb-rich forests classified by moisture and nutrient content									
M1.02.01	Dry mesotrophic herb-rich forests[5]	F	NT		CD1, CD2a	–	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, EXT 2, F 1, FDS 1, CST 1, IAS 1, MW 1	FTS 3, FCWD 2, FOG 2, F 1, FDS 1, CST 1, IAS 1, EXT 1, GP 1
		SF	NT		CD1, CD2a	–	EN	3		
		NF	NT		CD1	=	VU	3		
M1.02.02	Dry eutrophic herb-rich forests[5]	F	VU		CD1	–	EN	3	AGCL 3, FTS 3, FCWD 2, FOG 2, EXT 2, F 1, CST 1, FDS 1, IAS 1, GP 1, MW 1	FTS 3, FCWD 2, FOG 2, F 1, FDS 1, CST 1, IAS 1, GP 1, EXT 1
		SF	VU		CD1	–	EN	3		
		NF	NE				EN	5		
M1.02.03	Mesic mesotrophic herb-rich forests	F	VU		CD1	–	VU		AGCL 3, FTS 3, FCWD 2, FOG 2, F 1, DR 1, FDS 1, CST 1, IAS 1, MW 1, EXT 1	FTS 3, FCWD 2, FOG 2, F 1, IAS 1, FDS 1, CST 1, GP 1
		SF	VU		CD1	–	VU			
		NF	NT		CD1	=	NT			
M1.02.04	Mesic eutrophic herb-rich forests	F	EN		CD1	–	CR	3	AGCL 3, FTS 3, FCWD 2, FOG 2, GP 2, F 1, DR 1, FDS 1, CST 1, IAS 1, MW 1, EXT 1	FTS 3, FCWD 2, FOG 2, GP 2, F 1, IAS 1, FDS 1, CST 1, OTF 1, EXT 1
		SF	EN		CD1	–	CR	3		
		NF	VU		CD1	=	VU			
M1.02.05	Moist mesotrophic herb-rich forests	F	NT		CD1, CD2a	–	NT		AGCL 3, FTS 3, DR 3, FCWD 2, FOG 2, F 1, WHC 1, WBR 1, FDS 1, CST 1, IAS 1	FTS 3, DR 2, FCWD 2, FOG 2, F 1, IAS 1, FDS 1, GP 1, WBR 1, CST 1
		SF	NT		CD1, CD2a	–	NT			
		NF	NT		CD1	=	LC	3		
M1.02.06	Moist eutrophic herb-rich forests	F	VU		CD1	–	VU		AGCL 3, FTS 3, DR 3, FCWD 2, FOG 2, F 1, WHC 1, WBR 1, FDS 1, CST 1, IAS 1	FTS 3, DR 2, FCWD 2, FOG 2, GP 2, F 1, IAS 1, WBR 1, FDS 1, OTF 1, CST 1
		SF	VU		CD1	–	VU			
		NF	VU		CD1	=	NT	3		
M2	**Heath forests**									
M2.01	Herb-rich heath forest	F	VU		D3	+	NT	3	FOG 2	FCWD 3, FTS 2, FDS 2, FOG 2, F 1, GP 1, CC 1
		SF	VU		D3	+	NT	3		
		NF	NT		A1	–	NT			
M2.01.01	Young herb-rich heath forests	F	VU		D3	+	VU		FDS 3, FCWD 3, F 2	FDS 3, FCWD 3, FTS 2, FOG 2, F 2, GP 1, CC 1
		SF	VU		D3	+	VU			
		NF	VU		D3	=	EN	3		
M2.01.02	Mature conifer-dominated herb-rich heath forests	F	NT		D3	+	NT		FCWD 3	FCWD 3, FTS 2, FOG 2, F 1, GP 1, CC 1
		SF	NT		D3	+	NT			
		NF	LC			=	VU–EN	5, 3		
M2.01.03	Old conifer-dominated herb-rich heath forests	F	EN		A3	+	NT–EN	5, 3	FOG 3	FOG 3, FCWD 2, GP 1, CC 1
		SF	EN		A3	+	NT–VU	5, 3		
		NF	EN		A1, A3	–	NT–CR	5, 3		

[5]Dry mesotrophic and eutrophic herb-rich forests have been assessed as one assessment unit in Northern Finland and their results are included in the results of dry mesotrophic herb-rich forests.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
M2.02	Mesic heath forests	F	VU		D3	=	NT	3	FCWD 3, FDS 2, FOG 2, F 1	FCWD 3, FDS 2, FTS 2, FOG 2, F 1, GP 1, CC 1
		SF	VU		D3	=	NT	3		
		NF	NT		D3	=	NT			
M2.02.01	Young mesic heath forests	F	VU		D3	=	VU		FDS 3, FCWD 3, FTS 3, F 2, GP 1	FDS 3, FCWD 3, FTS 3, FOG 2, F 2, GP 1, CC 1
		SF	VU		D3	=	VU			
		NF	VU		D3	–	VU			
M2.02.02	Mature conifer-dominated mesic heath forests	F	NT		D3	+	NT[6]		FCWD 3, F 1	FCWD 3, FTS 2, FOG 2, F 1, GP 1, CC 1
		SF	VU		D3	+	NT[6]	5, 3		
		NF	NT		D1, D3	–	LC–VU	5, 3		
M2.02.03	Old conifer-dominated mesic heath forests	F	EN		A3	–	LC–VU	5, 3	FOG 3	FOG 3, FCWD 2, GP 1, CC 1
		SF	EN		A3	=	LC–VU	5, 3		
		NF	EN		A3	–	LC–VU	5, 3		
M2.02.04	Mature deciduous-dominated herb-rich and mesic heath forests	F	VU		A1, D3	=	VU–EN	5, 3	FOG 2, FCWD 2, FDS 1, GP 1	FCWD 3, FOG 2, FDS 1, FTS 1, F 1, GP 1
		SF	VU		A1, D3	=	EN–CR	5, 3		
		NF	VU		D1, D3	–	LC–VU	5, 3		
M2.02.05	Old deciduous-dominated herb-rich and mesic heath forests	F	VU		A1, D1, D3	–	EN–CR	5, 3	FOG 3, FCWD 1, GP 1	FOG 3, FCWD 2, FTS 1, GP 1
		SF	VU		A1, D3	–	EN–CR	5, 3		
		NF	EN		A1	–	VU–CR	5, 3		
M2.03	Sub-xeric heath forests	F	EN		D3	–	NT	3	FCWD 3, FDS 2, FOG 2, F 1, ADE 1	FCWD 3, FDS 2, FTS 2, FOG 2, F 1, ADE 1, GP 1, CC 1
		SF	EN		D3	–	NT	3		
		NF	VU		D3	–	LC	3		
M2.03.01	Young sub-xeric heath forests	F	EN		D3	–	VU	3	FDS 3, FCWD 3, F 2, ADE 1	FDS 3, FCWD 3, FTS 3, FOG 2, F 2, ADE 1, GP 1, CC 1
		SF	EN		D3	–	VU	3		
		NF	VU		D3	–	NT	3		
M2.03.02	Mature sub-xeric heath forests	F	VU		D3	–	NT–EN	5, 3	FCWD 3, FOG 2, FDS 2, FTS 2, F 1, ADE 1	FCWD 3, FTS 2, FOG 2, FDS 2, F 1, ADE 1, GP 1, CC 1
		SF	EN		D3	–	NT–CR	5, 3		
		NF	NT		D1, D3	–	LC–EN	5, 3		
M2.03.03	Old sub-xeric heath forests	F	EN		A3	=	NT–CR	5, 3	FOG 3, ADE 1	FOG 3, FCWD 2, FDS 1, ADE 1, GP 1, CC 1
		SF	CR		A3	+	NT–CR	5, 3		
		NF	EN		A3	=	LC–CR	5, 3		
M2.04	Xeric heath forest	F	EN		D3	–	NT	3	FDS 3, FCWD 3, ADE 2, FOG 2, GP 1, F 1	FDS 3, FCWD 3, ADE 2, FOG 2, GP 2, FTS 1, F 1, CC 1
		SF	EN		D3	–	VU	3		
		NF	VU		A1, D1, D3	–	NT	3		
M2.04.01	Young xeric heath forests	F	EN		D1, D3	–	VU	3	FDS 3, FCWD 3, ADE 2, F 1, GP 1	FDS 3, FCWD 3, ADE 2, FOG 2, FTS 1, F 1, GP 1, CC 1
		SF	CR		D3	–	VU	3		
		NF	EN		D1	–	VU	3		
M2.04.02	Mature xeric heath forests	F	VU		D3	–	NT–EN	5, 3	FCWD 3, ADE 2, FOG 2, FDS 2, GP 1	FCWD 3, ADE 2, FOG 2, FDS 2, GP 2, FTS 1, CC 1
		SF	VU		D3	=	NT–EN	5, 3		
		NF	VU		D1	–	NT–EN	5, 3		
M2.04.03	Old xeric heath forests	F	EN		A3	+	NT–EN	5, 3	FOG 2, ADE 2, GP 1	FOG 2, ADE 2, FDS 2, GP 2, FCWD 1, CC 1
		SF	CR		A3	+	EN[6]	5, 3		
		NF	EN		A3	=	NT–EN	5, 3		
M2.05	Barren heath forests	F	EN		D3	–	CR	3	ADE 3, FDS 3, FCWD 3, FOG 2, GP 2	ADE 3, FDS 3, FCWD 3, FOG 2, GP 1, CC 1
		SF	EN		D3	–	CR	3		
		NF	EN		A1	–	CR	3		
M3	**Special forest habitats**									
M3.01	Sun-exposed esker forests	F	VU		CD3	–	VU		FDS 3, F 2, ADE 2, EXT 2, CST 2, FCWD 1	FDS 3, F 2, ADE 2, CST 2, EXT 2, FCWD 1
		SF	EN		CD3	–	EN			
		NF	NT	NT–VU	CD3	–	NT			
M3.02	Inland dune forests	F	DD		CD1–CD3	=	VU	3		FDS 2, ADE 2, FOG 1, EXT 1, GP 1, MW 1, FCWD 1, CST 1
		SF	DD		CD1–CD3	=	VU	3		
		NF	DD		CD1–CD3	=	NT	3		
M3.03	Inland flooded forests	F	VU	NT–EN	A3	–	EN	3	WHC 3, WBR 3, AGCL 2, DR 2, FTS 2, FOG 1	WHC 3, WBR 3, DR 2, FTS 2, FOG 1, CC 1
		SF	EN	VU–CR	A3	–	CR	3		
		NF	NT	NT–EN	A3	–	NT			
M3.04	Forests on rocky terrain	F	NT		D3	=	LC	3, 5	FOG 1, GP 1, FTS 1, FCWD 1, ADE 1	FOG 1, GP 1, FTS 1, FCWD 1, ADE 1, EXT 1, CST 1, MW 1
		SF	NT		D3	=	LC	3, 5		
		NF	LC			=	NT	3, 5		

[6]In 2008 the habitat type was divided into several assessment units that had the same Red List category.

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
M3.05	Forests on ultrabasic soils	F	NT	LC–VU	B2b	=	VU	3	EXT 1, F 1	EXT 1, F 1
		SF	NT	LC–EN	B1,2b	=	VU	3		
		NF	NT	LC–EN	B1,2b	=	NT			
M3.06	Heath forests with deciduous (hardwood) trees	F	VU	VU–EN	A1, CD1	=	VU		FTS 3, AGCL 2, FOG 2, FCWD 2, GP 1, OTF 1, F 1, DR 1, CST 1	FTS 3, GP 2, FCWD 2, FOG 2, OTF 2, F 1, DR 1, IAS 1, CST 1
		SF	VU	VU–EN	A1, CD1	=	VU			
		NF								
K	**Rock outcrops and scree**									
K1	**Siliceous rock outcrops**									
K1.01	Acidic rock outcrops on seashores	F	LC			=	LC			CST 2, WEP 2, MW 1, ADE 1
		SF	LC			=	LC			
		NF								
K1.02	Acidic rock outcrops on lakeshores	F	LC			=	LC			CST 2, WBR 2, WEP 1, MW 1, ADE 1
		SF	LC	LC–NT		=	LC			
		NF	LC			=	LC			
K1.03	Acidic rock outcrops on riverbanks	F	NT	LC–NT	CD1	=	NT		WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1	WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1
		SF	NT	LC–NT	CD1	=	NT			
		NF	NT	LC–NT	CD1	=	NT			
K1.04	Acidic rock outcrops with *Racomitrium lanuginosum*	F	LC	LC–NT		=	NT	3		EXT 1, CST 1, MW 1, ADE 1, F 1
		SF	LC	LC–NT		=	NT	3		
		NF								
K1.05	Acidic rock outcrops with reindeer lichen and mosses	F	LC	LC–NT		=	LC		F 2, ADE 1, EXT 1, CST 1	F 2, ADE 1, EXT 1, CST 1
		SF	NT	LC–VU	D3	–	LC	2		
		NF	LC	LC–NT		=	LC			
K1.06	Acidic well-lighted rock faces	F	LC			=	LC			F 1, CST 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K1.07	Acidic shady rock faces	F	NT	LC–NT	D3	–	NT		F 2, CST 1	F 2, CST 1
		SF	NT	LC–NT	D3	–	NT			
		NF	LC			=	LC			
K1.08	Acidic overhanging rock faces	F	NT	LC–NT	D3	–	NT		F 2, MW 1, CST 1	F 2, MW 1, CST 1
		SF	NT	LC–NT	D3	–	NT			
		NF	LC			=	LC			
K1.09	Siliceous rock faces with seepage water	F	LC			=	LC			F 1, CST 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K1.10	Siliceous weathered rocks	F	DD		B2, D1–D3	?	NT	3		EXT 2, F 2
		SF	DD		B1, B2, D1–D3	?	NT	3		
		NF	DD		B1, B2, D1–D3	?	LC	3		
K1.11	Intermediate-basic rock outcrops on seashores	F	NT	LC–NT	CD1	–	NT		CST 2, WEP 2, CHE 1, MW 1, ADE 1	CST 2, WEP 2, MW 1, CHE 1, ADE 1
		SF	NT	LC–NT	CD1	–	NT			
		NF								
K1.12	Intermediate-basic rock outcrops on lakeshores	F	NT	LC–NT	CD1	–	NT		CST 2, WBR 2, WEP 1, CHE 1, MW 1, ADE 1	CST 2, WBR 2, CHE 1, WEP 1, MW 1, ADE 1
		SF	NT	LC–NT	CD1	–	NT			
		NF	LC			=	LC			
K1.13	Intermediate-basic rock outcrops on riverbanks	F	NT	LC–NT	CD1	=	NT		WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1	WBR 2, WHC 2, WEP 1, CST 1, CHE 1, MW 1
		SF	NT	LC–NT	CD1	=	NT			
		NF	NT	LC–NT	CD1	=	NT			
K1.14	Intermediate-basic open flat rocks	F	NT		A1	–	NT		ADE 2, F 2, CHE 1, CST 1, EXT 1	ADE 2, F 2, CHE 1, CST 1, EXT 1
		SF	NT		A1	–	NT			
		NF	LC			=	LC			
K1.15	Intermediate-basic well-lighted rock faces	F	LC			=	LC			F 1, CST 1, CHE 1, ADE 1
		SF	LC			=	LC			
		NF	LC			=	LC			

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K1.16	Intermediate-basic shady rock faces	F	NT	LC–VU	D3	–	NT		F 2, CST 1, CHE 1, ADE 1	F 2, CST 1, CHE 1, ADE 1
		SF	NT	LC–VU	D3	–	NT			
		NF	LC			=	LC			
K1.17	Intermediate-basic overhanging rock faces	F	NT	LC–VU	D3	–	NT		F 2, MW 1, CST 1	F 2, MW 1, CST 1
		SF	NT	LC–VU	D3	–	NT			
		NF	LC			=	LC			
K2	**Calcareous rock outcrops**	F	NT		A3, D1, D3	–	VU	3	EXT 3, F 2, ADE 2, CST 2, WEP 1, WHC 1, CHE 1	F 2, ADE 2, CST 2, EXT 2, WEP 1, CHE 1
		SF	VU		A3, D1, D3	–	VU			
		NF	NT		B1,2a(iii)b	?	NT			
K2.01	Calcareous rock outcrops on seashores	F	EN		B1a(ii,iii)b	–	VU	3	EXT 3, CST 3, WEP 3, ADE 2, CHE 1	CST 3, WEP 3, ADE 2, CHE 1
		SF	EN		B1a(ii,iii)b	–	VU	3		
		NF								
K2.02	Calcareous rock outcrops on lakeshores	F	VU		B2a(ii,iii)b	–	VU		CST 3, EXT 2, ADE 2, WEP 1, F 1, CHE 1	CST 3, ADE 2, WEP 1, F 1, CHE 1
		SF	EN		B2a(ii,iii)b	–	VU	3		
		NF	VU		B1,2c	?	NT	3		
K2.03	Calcareous rock outcrops on riverbanks	F	NT	LC–EN	A1, B1,2a(ii)b	?	NT		WHC 2, WBR 2, CST 1, F 1, WEP 1	WHC 2, WBR 2, CST 1, F 1, WEP 1
		SF	EN		B1,2a(ii)bc	–	EN			
		NF	NT	LC–EN	A1, B1,2a(ii)b	?	NT			
K2.04	Calcareous open flat rock outcrops	F	EN		A1, A3, B2a(iii)b	–	CR	3	EXT 3, ADE 3, F 2, CST 2, CHE 1	ADE 3, F 2, CST 2, EXT 2, CHE 1
		SF	EN		A1, A3, B2a(iii)b	–	CR	3		
		NF	DD		A1–A3, B1–B3, D1, D3	?	DD			
K2.05	Calcareous wooded flat rock outcrops	F	NT	LC–VU	A3	–	VU	3	EXT 3, ADE 3, F 2, CST 2	ADE 3, F 2, CST 2, EXT 2
		SF	VU	NT–VU	A3	–	VU			
		NF	DD		B1, B2, D1, D3	?	VU	3		
K2.06	Calcareous well-lighted rock faces	F	VU		B2a(iii)b, D1	–	NT	3	EXT 3, F 2, CST 2, ADE 1	F 2, CST 2, ADE 1, EXT 1
		SF	VU		A3, B2a(iii)b, D1, D3	–	EN	3		
		NF	NT	LC–EN	B1,2a(iii)b	?	NT			
K2.07	Calcareous shady rock faces	F	VU	NT–VU	D1	–	VU		EXT 3, F 2, CST 2, ADE 1	F 2, CST 2, ADE 1, EXT 1
		SF	VU		A3, B2a(iii)b, D1, D3	–	VU			
		NF	NT	LC–EN	B1,2a(iii)b	?	NT			
K3	**Serpentine rock outcrops and scree**									
K3.01	Serpentine rock outcrops on shores	F	NT	LC–EN	B1,2a(iii)b	–	VU	3	CST 1-2, WBR 1-2, F 1	CST 1-2, WBR 1-2, F 1, EXT 1
		SF	NT	LC–EN	B1,2a(iii)b	–	VU	3		
		NF	EN		B1,2c	?	EN			
K3.02	Flat serpentine rock outcrops	F	VU	NT–VU	B2a(iii)b	–	VU		F 2, EXT 2, WHC 1	F 2, EXT 2
		SF	VU	VU–EN	B2a(iii)b	–	VU			
		NF	VU		B2a(iii)b	–	VU			
K3.03	Serpentine oligotrophic rock faces	F	VU		B2a(iii)b	–	VU		F 2, EXT 2, WHC 1	F 2, EXT 2
		SF	EN	VU–EN	B2a(iii)b	–	VU	3		
		NF	EN		B2a(iii)b	–	VU	3		
K3.04	Serpentine calcareous rock faces	F	VU		B2a(iii)b	–	VU		F 2, EXT 2, WHC 1	F 2, EXT 2
		SF	EN		B2a(iii)b	–	VU	3		
		NF	EN		B2a(iii)b	–	VU	3		
K3.05	Serpentine scree (block and gravel fields)	F	VU		B2a(iii)b	–	NT	3	F 2, EXT 1	F 2, EXT 1
		SF	EN		B2a(iii)b	–	–	2		
		NF	VU		B2a(iii)b	–	NT	3		
K4	**Fe and Cu sulphide-rich rock outcrops**	F	LC			=	NT	3		F 2, EXT 1, CST 1
		SF	LC			=	NT	3		
		NF	LC			=	LC			

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K5	**Scree**									
K5.01	Boulder fields of raised beaches near the Baltic coast (rather young)	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF								
K5.02	Boulder fields of raised beaches inland (ancient)	F	LC			=	NT	3		EXT 1, F 1
		SF	LC			=	NT	3		
		NF	LC			=	LC			
K5.03	Fluvial boulder fields	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.04	Frost-weathered boulder fields	F	LC			=	LC			
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.05	Frost-heaved boulder fields	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.06	Moraine boulder fields	F	LC			=	LC			F 1, EXT 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.07	Taluses									
K5.07.01	Siliceous taluses	F	LC			=	LC			F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.07.02	Calcareous taluses	F	VU		B1,2c	?		4	F 1	F 1
		SF								
		NF	VU		B1,2c	?		4		
K5.08	Erratic boulders, tors and stacks									
K5.08.01	Siliceous erratic boulders, tors and stacks	F	LC			=	LC			
		SF	LC			=	LC			
		NF	LC			=	LC			
K5.08.02	Calcareous erratic boulders	F	VU		B2a(iii)b	–	NT	3	EXT 3, F 2	F 2
		SF	VU		B2a(iii)b	–	NT	3		
		NF	EN		B2a(iii)b	–	NT	3		
K5.08.03	Serpentine erratic boulders	F	DD		B1, B2, D1–D3	?	NT	3		F 1
		SF	DD		B1, B2, D1–D3	?	NT	3		
		NF	DD		B1, B2, D1–D3	?	NT	3		
K6	**Complexes of rocky habitats**									
K6.01	Canyons	F	LC			=	LC			F 1, CST 1, MW 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K6.02	Gorges	F	LC			=	LC			MW 1, F 1
		SF	LC			=	LC			
		NF	LC			=	LC			
K6.03	Caves	F	LC			=	LC			MW 1
		SF	LC			=	LC			
		NF	LC			=	LC			
P	**Seminatural grasslands and grazed woodlands**									
P01	**Heaths**	F	EN	EN–CR	A1, A3, CD1	–	CR	3	OGR 3, FDS 2, ADE 2, F 1, CST 1	OGR 3, FDS 2, ADE 2, CST 1, CC 1, CHE 1
		SF	EN	EN–CR	A1, A3, CD1	–	CR	3		
		NF								
P01.01	Herb-rich heaths	F	CR		A1, CD1	–	CR		OGR 3, FDS 2, ADE 2, F 1, CST 1	OGR 3, FDS 2, ADE 2, CST 1, MW 1, F 1, CC 1, CHE 1, IAS 1
		SF	CR		A1, CD1	–	CR			
		NF								
P01.02	Graminoid heaths	F	EN		A1, CD1	–	CR	2, 3	OGR 3, ADE 2, FDS 2	OGR 3, ADE 2, CC 1, CST 1, IAS 1
		SF	EN		A1, CD1	–	CR	2, 3		
		NF								
P01.03	Dwarf-shrub heaths	F	EN	EN–CR	A1, CD1	–	EN		OGR 3, FDS 2, ADE 2, F 1, CST 1	OGR 3, FDS 2, ADE 2, CST 1, MW 1, F 1, CC 1, CHE 1
		SF	EN	EN–CR	A1, CD1	–	EN			
		NF								

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P02	**Rock meadows**	F	CR		A3	–	EN	3	OGR 3, EP 2, CST 2, EXT 2, F 1	EP 3, OGR 3, CST 2, ADE 2, F 1, EXT 1
		SF	CR		A3	–	EN	3		
		NF								
P02.01	Calcareous rock meadows	F	CR		A1, A3	–	CR		EXT 3, OGR 3, EP 2, CST 2, ADE 2, F 1	OGR 3, CST 2, F 2, EP 2, ADE 2, EXT 1
		SF	CR		A1, A3	–	CR			
		NF								
P02.02	Acidic rock meadows	F	CR		A3	–	EN	3	OGR 3, EP 2, F 1, CST 1, ADE 1	OGR 3, EP 2, F 2, ADE 2, CST 1
		SF	CR		A3	–	EN	3		
		NF								
P03	**Dry meadows**	F	CR		A1, A3	–	CR		OGR 3, AGCL 3, EP 2, F 2, CST 1, EXT 1, ADE 1	OGR 3, EP 2, CST 2, F 1, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P03.01	Calcareous dry meadows	F	CR		A1	–	CR		OGR 3, F 2, AGCL 2, EXT 2, EP 1, CST 1, ADE 1	OGR 3, F 2, CST 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF								
P03.02	Acidic low-herb-rich dry meadows	F	CR		A1	–	CR		OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1	OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF	DD		A1–A3, B1–B2, CD1–CD3	?	DD			
P03.03	Dwarf-shrub-rich dry meadows	F	CR		A1	–	CR		OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1	OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF	CR		A1	–	CR			
P03.04	*Avenula pubescens* dry meadows	F	CR		A1	–	CR		OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1	OGR 3, F 2, CST 1, AGCL 1, EP 1, ADE 1
		SF	CR		A1	–	CR			
		NF								
P03.05	Grass-rich dry meadows	F	CR		A1	–	CR		OGR 3, EP 2, AGCL 2, F 1, ADE 1	OGR 3, EP 2, CST 1, F 1, AGCL 1, ADE 1
		SF	CR		A1	–	CR			
		NF	CR		A1	–	CR			
P04	**Mesic meadows**	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, EP 2, F 2, IAS 2, CST 2, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P04.01	Low-herb mesic meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, EP 2, F 2, IAS 2, CST 2, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P04.02	Tall-herb mesic meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, EP 2, F 2, IAS 2, CST 2, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P04.03	Graminoid mesic meadows	F	CR		A1, A3	=	EN	3	AGCL 3, OGR 3, F 2, EP 2, ADE 1, CHE 1, IAS 1, CST 1	OGR 3, F 2, EP 2, AGCL 1, IAS 1, CST 1, ADE 1
		SF	CR		A1, A3	=	EN	3		
		NF	CR		A1, A3	=	CR			
P05	**Moist meadows**	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1, CST 1	OGR 3, AGCL 2, DR 1, F 1, EP 1, CST 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P05.01	Calcareous moist meadows	F	CR		A1	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1, CST 1	OGR 3, AGCL 2, DR 1, F 1, EP 1, CST 1
		SF	CR		A1	–	CR			
		NF								
P05.02	Herb-rich moist meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1, CST 1	OGR 3, AGCL 2, DR 1, F 1, EP 1, CST 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P05.03	Grass-rich moist meadows	F	CR		A1, A3	–	CR		AGCL 3, OGR 3, DR 2, F 1, EP 1	OGR 3, DR 2, EP 2, F 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P06	**Freshwater meadows**	F	CR		A1, A3	–	EN	3	OGR 3, WEP 3, WHC 2, WBR 2, DR 2, CST 2, IAS 2, AGCL 1	OGR 3, R 2, WHC 2, DR 2, IAS 2
		SF	CR		A1, A3	–	EN	3		
		NF	CR		A1, A3	–	EN	3		
P06.01	*Eleocharis acicularis* freshwater meadows	F	CR		A1, A3	–	DD	2	OGR 3, WEP 3, WHC 2, WBR 2, DR 2, CST 2, IAS 2	OGR 3, CST 2, WHC 2, DR 2, IAS 2
		SF	CR		A1, A3	–	DD	2		
		NF	DD		A1–A3, B1–B2, CD1–CD3	?	DD			
P06.02	*Equisetum fluviatile-Schoenoplectus lacustris* freshwater meadows	F	CR		A1, A3	–	DD	2	OGR 3, WEP 3, WHC 2, IAS 2	OGR 3, WHC 2, IAS 2, CST 2
		SF	CR		A1, A3	–	DD	2		
		NF	CR		A1, A3	–	DD	2		

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P06.03	Tall-sedge freshwater meadows	F	CR		A1, A3	–	EN	2	OGR 3, WEP 3, WHC 2, IAS 2	OGR 3, WHC 2, IAS 2, CST 2
		SF	CR		A1, A3	–	EN	2		
		NF	CR		A1, A3	–	VU	2		
P06.04	Low freshwater graminoid meadows	F	CR		A1, A3	–	CR		OGR 3, WEP 2, WHC 2, WBR 2, DR 2, CST 2, AGCL 1	OGR 3, CST 2, WHC 2, DR 2
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P06.05	Tall freshwater meadows	F	CR		A1, A3	=	EN	2	OGR 3, AGCL 2, DR 2, CST 2, IAS 2, WEP 1, WHC 1, WBR 1	OGR 3, DR 2, IAS 2, CST 1, WHC 1
		SF	CR		A1, A3	=	EN	2		
		NF	CR		A1, A3	=	VU	2		
P07	**Seashore meadows**	F	CR		A1, A3	–	CR		OGR 3, AGCL 3, WEP 2, WHC 2, DR 2, CST 1	OGR 3, WEP 2, WHC 2, DR 2, CC 2
		SF	CR		A1, A3	–	CR			
		NF								
P07.01	*Eleocharis parvula-E. acicularis* seashore meadows	F	CR	VU–CR	A1	–	DD	2	OGR 3, CC 2, WHC 1	OGR 3, WEP 2, WHC 1, CC 1
		SF	CR	VU–CR	A1	–	DD	2		
		NF								
P07.02	*Eleocharis palustris-Schoenoplectus tabernaemontani-Bolboschoenus maritimus* seashore meadows	F	CR		A1	–	DD	2, 5	OGR 2, WHC 1, DR 1	OGR 2, WHC 2, DR 2
		SF	CR		A1	–	DD	2, 5		
		NF								
P07.03	Tall-sedge seashore meadows	F	CR		A1	–	CR		OGR 3, WEP 2, WHC 1, DR 1	OGR 3, WEP 1, WHC 1, DR 1, CC 1
		SF	CR		A1	–	CR			
		NF								
P07.04	Low-graminoid seashore meadows	F	CR		A1	+	CR		OGR 3, WEP 2, WHC 2, DR 2, AGCL 2, CST 1	OGR 3, WEP 2, WHC 2, DR 2, CC 1
		SF	CR		A1	+	CR			
		NF								
P07.05	Tall seashore meadows	F	CR		A1	–	EN	5	OGR 3, WEP 2, DR 2, AGCL 2, WHC 1, CST 1	OGR 3, DR 2, CC 2, WEP 1, WHC 1
		SF	CR		A1	–	EN	5		
		NF								
P07.06	Salt patches	F	CR		A1	–	CR		OGR 3, WEP 2, DR 2, AGCL 2, WHC 1, CST 1	OGR 3, WEP 2, DR 2, WHC 1, CC 1
		SF	CR		A1	–	CR			
		NF								
P08	**Alluvial meadows**	F	CR		A1, A3	–	EN	3	WHC 3, WBR 3, OGR 3, AGCL 2, WEP 1	OGR 3, WBR 3, WHC 2, CC 2, WEP 1, AGCL 1
		SF	CR		A1, A3	–	EN	3		
		NF	CR		A1, A3	–	EN	3		
P08.01	*Equisetum fluviatile alluvial* meadows	F	CR		A1, A3	=	NT	3	WHC 3, WBR 3, WEP 1	WBR 3, WHC 2, CC 2, WEP 1
		SF	CR		A3	=	NT	3		
		NF	CR		A1, A3	=	NT	3		
P08.02	Tall-sedge alluvial meadows	F	CR		A1, A3	=	NT	3	WHC 3, WBR 3, AGCL 2, OGR 1, WEP 1	WBR 3, WHC 2, CC 2, WEP 1, AGCL 1, OGR 1
		SF	CR		A1, A3	=	NT	3		
		NF	CR		A1, A3	=	NT	3		
P08.03	Moist graminoid alluvial meadows	F	CR		A1, A3	=	VU	3	WHC 3, WBR 3, OGR 2, AGCL 1, WEP 1	WBR 3, WHC 2, OGR 2, CC 2, AGCL 1, WEP 1
		SF	CR		A3	=	VU	3		
		NF	CR		A1, A3	=	VU	3		
P08.04	Mesic graminoid alluvial meadows	F	CR		A1, A3	–	CR		WHC 3, WBR 3, OGR 3, AGCL 2	OGR 3, WBR 3, WHC 2, CC 2, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P08.05	Mesic tall-herb alluvial meadows	F	CR		A1, A3	–	CR		WHC 3, WBR 3, OGR 3, AGCL 2	OGR 3, WBR 3, WHC 2, CC 2, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P08.06	Dry low-herb alluvial meadows	F	CR		A1, A3	–	CR		WHC 3, WBR 3, OGR 3, AGCL 2	OGR 3, WBR 3, WHC 2, CC 2, AGCL 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P09	**Fen meadows**	F	CR		A1, A3	–	CR		OGR 3, DR 2, F 1, PE 1, AGCL 1, WHC 1	OGR 3, DR 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P10	**Pollard meadows**	F	CR		A3	–	CR		AGCL 3, OGR 3, F 3, EP 2, ADE 1, CST 1	OGR 3, FTS 2, EP 2, ADE 2, CST 1, F 1
		SF	CR		A3	–	CR			
		NF								

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
P11	**Wooded pastures**	F	CR		A1, A3	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 2, FTS 2, CST 1	OGR 3, F 3, EP 3, FCWD 2, FTS 2, CST 1, AGCL 1, ADE 1
		SF	CR		A1, A3	–	CR			
		NF	CR		A1, A3	–	CR			
P11.01	Wooded pastures dominated by deciduous hardwood trees	F	CR		A1	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 3, FTS 2, ADE 2, CST 1	OGR 3, F 3, EP 3, FCWD 3, FTS 2, ADE 2, CST 1, AGCL 1
		SF	CR		A1	–	CR			
		NF								
P11.02	Wooded pastures dominated by deciduous trees	F	CR		A1	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 3, FTS 2, ADE 2, CST 1	OGR 3, F 3, EP 3, FCWD 3, FTS 2, CST 1, AGCL 1, ADE 1
		SF	CR		A1	–	CR			
		NF	DD		A1–A3, B1, B2	–	CR	3		
P11.03	Wooded pastures with deciduous and coniferous trees	F	CR		A1	–	CR		F 3, AGCL 3, OGR 3, EP 3, FCWD 3, FTS 2, CST 1	OGR 3, F 3, EP 3, FCWD 3, FTS 2, CST 1, AGCL 1
		SF	CR		A1	–	CR			
		NF	DD		A1–A3, B1, B2	–	CR	3		
P11.04	Wooded pastures dominated by coniferous trees	F	CR		A1	?	CR		F 3, AGCL 3, OGR 3, EP 2	OGR 3, F 3, FCWD 2, EP 2, CST 1, AGCL 1
		SF	CR		A1	?	CR			
		NF	DD		A1–A3, B1, B2	?	CR	3		
P12	**Grazed woodlands**	F	CR		A1, A3	?	EN	3	F 3, OGR 3, FTS 2, AGCL 2, EP 2, FOG 1	OGR 3, F 3, FTS 2, EP 2, FCWD 2, FOG 1
		SF	CR		A1, A3	?	EN	3		
		NF	CR		A1, A3	?	CR			
P12.01	Grazed woodlands dominated by deciduous trees	F	CR		A1, A3	?	CR		F 3, OGR 3, AGCL 2, EP 2, FTS 2, FOG 1	OGR 3, F 3, FTS 3, EP 2, FOG 2, FCWD 1
		SF	CR		A1, A3	?	CR			
		NF	CR		A1	?	CR			
P12.02	Grazed woodlands with deciduous and coniferous trees	F	CR		A1, A3	?	CR		F 3, OGR 3, AGCL 2, EP 2, FTS 2, FOG 1	OGR 3, F 3, FTS 2, FCWD 2, EP 2, FOG 1
		SF	CR		A1, A3	?	CR			
		NF	CR		A1	?	CR			
P12.03	Grazed woodlands dominated by coniferous trees	F	CR		A1, A3	?	EN	3	F 3, OGR 3, EP 2, AGCL 1, FOG 1	OGR 3, F 3, FCWD 2, EP 2, FOG 1
		SF	CR		A1, A3	?	EN	3		
		NF	CR		A1	?	CR			
T	**Fell habitats**									
T01	**Mountain birch forests**	F	VU	VU–EN	A2a, CD1, CD3	–	NT	3, 1, 2	GP & CC 3, GP 3, CC 2	GP & CC 3, GP 3, CC 2, MW 1, CST 1
T01.01	Dry and dryish mountain birch forests									
T01.01.01	*Empetrum-Lichenes* mountain birch forests	F	CR		D1	–	VU	3, 1, 2	GP & CC 3, GP 3, CC 2	GP & CC 3, GP 3, CC 2
T01.01.02	*Empetrum-Lichenes-Pleurozium* mountain birch forests	F	VU	NT–EN	A2a, CD1, CD3	–	NT	3, 1, 2	GP & CC 3, GP 3, CC 2	GP & CC 3, GP 3, CC 2
T01.01.03	*Empetrum-Myrtillus* mountain birch forests	F	VU	VU–EN	A2a, CD1, CD3	–	NT	3, 1, 2	GP & CC 3, GP 2, CC 2	GP & CC 3, GP 2, CC 2
T01.02	Mesic mountain birch forests									
T01.02.01	*Empetrum* mountain birch forests	F	EN		B1,2a(i,ii,iii)bc	–	VU	3, 1, 2	GP & CC 3, CC 2, GP 2	GP & CC 3, CC 2, GP 2, CST 2, MW 1
T01.02.02	*Cornus-Empetrum-Myrtillus* mountain birch forests	F	VU		B1,2a(iii)bc, CD1, CD2a	–	NT	3, 1, 2	GP & CC 2, GP 2, CC 1	GP & CC 2, GP 2, CC 1, MW 1, CST 1
T01.02.03	*Cornus-Myrtillus* mountain birch forests	F	VU	VU–EN	B1,2a(iii)bc, CD1, CD2a	–	NT	3, 1, 2	GP & CC 2, GP 2, CC 1	GP & CC 2, GP 2, CC 1, MW 1, CST 1
T01.03	Herb-rich mountain birch forests									
T01.03.01	Low-herb mountain birch forests	F	NT	NT–VU	A2a, CD1, CD3	–	NT		GP & CC 2, GP 1, CC 1	GP & CC 2, GP 1, CC 1
T01.03.02	Tall-herb mountain birch forests	F	VU		B1,2a(i,ii,iii) bc, CD1, CD2a	–	NT	3, 1, 2	GP & CC 2, CC 1, GP 1	GP & CC 2, CC 1, GP 1, MW 1, CST 1
T01.03.03	Fern-rich mountain birch forests	F	NT		B1,2b, CD2a	–	NT		GP & CC 1–2, CC 1, GP 1	GP & CC 1–2, CC 1, GP 1
T02	**Mountain forests with aspen, pine or spruce**									
T02.01	Mountain forests with aspen	F	LC			+		4		GP 1
T02.02	Mountain forests with pine	F	LC			+		4		GP 1
T02.03	Mountain forests with spruce		LC			+		4		GP 1

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
T03	**Mountain heath scrubs**									
T03.01	Mountain *Salix* scrubs	F	LC			=	NT	2, 3		GP 2, GP & CC 1
T03.02	Mountain *Juniperus communis* scrubs	F	LC			=	LC			
T03.03	Mountain birch scrubs	F	NT		A1, A2a	–	NT		GP 2, GP & CC 2, CC 1	GP 2, GP & CC 2, CC 1
T04	**Mountain heaths**	F	NT	NT–VU	A2a, CD1, CD3	–	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.01	Wind-exposed mountain heaths	F	VU		CD1	–	VU		GP 3	GP 3, MW 1
T04.02	*Empetrum* mountain heaths	F	NT	NT–VU	A2a, CD1, CD3	–	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.03	*Betula nana* mountain heaths	F	NT	NT–VU	CD1, CD3	–	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.04	*Myrtillus* mountain heaths	F	NT		CD1–CD3	=	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.05	*Phyllodoce caerulea* mountain heaths	F	NT		CD1–CD3	=	NT		GP 2, CC 2, GP & CC 1	GP 2, CC 2, GP & CC 1
T04.06	*Calluna* mountain heaths	F	VU		CD2a	–	VU		CC 3, GP 1, CST 1	CC 3, GP 1, CST 1, MW 1
T04.07	*Cassiope tetragona* mountain heaths	F	NT	NT–EN	B1,2a(ii,iii)b	–	NT		GP 1–2	GP 1–2, CC 1
T04.08	Calcareous Dryas *octopetala* mountain heaths	F	NT	LC–EN	B1,2a(ii,iii)b	–	VU	3	GP 1–2, CC 1, GP & CC 1	GP 1–2, CC 1, GP & CC 1
T04.09	Non-calcareous Dryas *octopetala* mountain heaths	F	VU		B1,2bc, CD2a	–		4	CC 2, GP 1, GP & CC 1	CC 2, GP 1, GP & CC 1
T05	**Low-graminoid mountain heaths**									
T05.01	*Nardus stricta* mountain heaths	F	LC			=	LC			CC 1
T05.02	*Festuca ovina-Juncus trifidus* mountain heaths	F	LC			=	LC			CC 1
T06	**Mountain meadows**									
T06.01	Low-herb mountain meadows	F	LC			=	LC			CC 1
T06.02	Tall-herb mountain meadows	F	NT	NT–EN	B1,2a(ii,iii) b, CD1	=	NT		CC 2, GP 2, GP & CC 1–2	CC 2, GP 2, GP & CC 1–2
T06.03	*Salix*-rich brookside mountain meadows	F	LC			=	LC			
T06.04	Fern-rich mountain meadows	F	LC			=	NT	3		CC 1
T07	**Snowbeds and snow patches**									
T07.01	Snowbeds	F	CR	EN–CR	A2a	–	NT	2, 3, 1	CC 3, GP 1	CC 3, GP 1
T07.01.01	Oligotrophic snowbeds									
T07.01.01.01	Oligotrophic *Salix herbacea* snowbeds	F	CR	EN–CR	A2a	–	LC	2, 3, 1	CC 3	CC 3
T07.01.01.02	Oligotrophic low-graminoid snowbeds	F	CR	EN–CR	A2a	–	LC	2, 3, 1	CC 3	CC 3
T07.01.01.03	Oligotrophic low-herb snowbeds	F	CR	EN–CR	A2a	–	NT	2, 3, 1	CC 3	CC 3
T07.01.01.04	Oligotrophic bryophyte-rich snowbeds	F	CR	EN–CR	A2a	–	NT	2, 3, 1	CC 3	CC 3
T07.01.01.05	Oligotrophic *Ranunculus glacialis* snowbeds	F	EN		B1,2a(i,ii,iii) b, C2b	–	NT	2, 3, 1	CC 3, GP 2	CC 3, GP 2
T07.01.02	Eutrophic snowbeds									
T07.01.02.01	Eutrophic heathlike snowbeds	F	EN		B1,2a(i,ii,iii) b, C2b	–	NT	2, 3, 1	CC 3	CC 3
T07.01.02.02	Eutrophic low-herb snowbeds	F	EN		B1,2a(i,ii,iii) b, C2b	–	NT	2, 3, 1	CC 3	CC 3
T07.01.02.03	Eutrophic bryophyte-rich snowbeds	F	CR		B1a(i,ii,iii)b	–	VU	2, 3, 1	CC 3	CC 3, GP 1
T07.02	Snow patches	F	CR		B1a(i,ii)b	–	EN	2, 3, 1	CC 3	CC 3
T08	**Patterned grounds and solifluction sheets**									
T08.01	Patterned grounds	F	NT	LC–NT	CD2a	–	LC	2, 3	CC 1	CC 1, GP 1
T08.02	Solifluction sheets	F	NT	LC–NT	CD2a	–	LC	2, 3	CC 1	CC 1, GP 1
T09	**Frost-influenced heaths**	F	VU		CD2a	–	LC	2, 3	CC 2	CC 2

Code	Habitat type	Area	Category 2018	Range of category	Criteria	Current trend	Category 2008	Reason for category change	Reasons for becoming threatened	Threat factors
T10	**Mountain dunes and deflation basins**	F	NT		A2a, B1,2b	–	LC	2, 5, 3	CC 1–2	CC 1–2, MW 1, GP 1
T11	**Mountain rock outcrops and boulder fields**									
T11.01	Mountain acidic and intermediate-basic flat rock outcrops	F	LC			=	LC			GP 1, MW 1
T11.02	Mountain acidic and intermediate-basic steeps	F	LC			=	LC			
T11.03	Mountain calcareous rock outcrops and boulder fields	F	LC			=	NT	3		MW 1, RTF 1
T11.04	Mountain serpentine rock outcrops and boulder fields	F	LC			=	NT	3		RTF 1
T11.05	Fe and Cu sulphide-rich rock outcrops and boulder fields	F	LC			=		4		EXT 1, CST 1, MW 1
T11.06	Mountain acidic and intermediate-basic boulder fields	F	LC			=	LC			
T11.07	Talus formations									
T11.07.01	Acidic and intermediate-basic talus formations	F	LC			=	LC			
T11.07.02	Calcareous talus formations	F	LC			=	NT	3		RTF 1
T12	**Fell habitat complexes**									
T12.01	Canyons	F	LC			=		4		
T12.02	Gorges and channels	F	LC			=		4		

DESCRIPTION SHEET

Published by	Finnish Environment Institute and Ministry of the Environment		December 2019
Authors	Kontula, T. & Raunio, A. (eds.)		
Title of publication	Threatened Habitat Types in Finland 2018 Red List of Habitats Results and Basis for Assessment		
Series and publication number	The Finnish Environment 2/2019		
Register number	-	Subject	Nature
ISBN printed	-	ISSN printed	-
ISBN PDF	978-952-11-5110-1	ISSN online	1796-1637
Website address (URN)	http://urn.fi/URN:ISBN:978-952-11-5110-1		
Pages	254	Language	English
Keywords	threatened habitat types, biotopes, Baltic Sea, coast, inland waters, shores, mires, forests, rocky habitats, seminatural grasslands, fell habitats		

Abstract

This publication summarises Part 1 of the final report on threatened habitat types published in Finnish. It presents the assessment method, the results and their justifications as well as a summary of action proposals drawn up by expert groups. The habitat type descriptions, distribution maps, photographs and habitat type-specific justifications can be found in Part 2 of the publication only available in Finnish.

The assessment of threatened habitat types covered all natural habitat types and seminatural grasslands and wooded pastures in Finland. Assessment results are presented for 388 habitat types. Habitat types were divided into eight main groups: Baltic Sea (42 habitat types, 24% assessed as threatened), Baltic Sea coast (45, 58%), inland waters and shores (59, 20%), mires (69, 57%), forests (34, 76%), rock outcrops and scree (44, 25%), seminatural grasslands and wooded pastures (42, 100%) and fell habitats (53, 38%).

This was the second assessment of threatened habitat types in Finland. This assessment was conducted using the international IUCN Red List of Ecosystems method. The primary assessment criteria were change in habitat type quantity, change in abiotic and biotic quality, and rarity. The current trends for habitat types in terms of their state were also assessed.

Altogether 186 habitat types (48% of the total number of habitat types) were assessed as being threatened in the whole of Finland. The percentage of threatened habitat types in Southern Finland (59%) is clearly higher than in Northern Finland (32%). Because of the changes in assessment methodology, the results of the first and second assessment of threatened habitat types are not directly comparable with each other. The results do, however, lend themselves to the interpretation that the risk of habitat type loss has not been reduced.

Publisher	Ministry of the Environment
Printed by (place and time)	-
Distributed by/ publication sales	The publication is available in the internet (pdf): syke.fi/publications | helda.helsinki.fi/syke

KUVAILULEHTI

Julkaisija	Suomen ympäristökeskus ja ympäristöministeriö		Joulukuu 2019
Tekijät	Kontula, T. & Raunio, A. (toim.)		
Julkaisun nimi	Suomen luontotyyppien uhanalaisuus 2018 Luontotyyppien punainen kirja Tulokset ja arvioinnin perusteet		
Julkaisusarjan nimi ja numero	Suomen ympäristö 2/2019		
Diaari/ hankenumero	-	Teema	Luonto
ISBN painettu	-	ISSN painettu	-
ISBN PDF	978-952-11-5110-1	ISSN verkkojulkaisu	1796-1637
URN-osoite	http://urn.fi/URN:ISBN:978-952-11-5110-1		
Sivumäärä	254	Kieli	englanti
Asiasanat	Uhanalaiset luontotyypit, biotoopit, Itämeri, rannikko, sisävedet, rannat, suot, metsät, kalliot, perinnebiotoopit, tunturit		

Tiivistelmä

Julkaisu on tiivistelmä luontotyyppien uhanalaisuusarvioinnin loppuraportin ensimmäisestä osasta. Siinä esitellään luontotyyppien uhanalaisuuden arviointimenetelmä, arvioinnin tulokset ja perusteet sekä kooste asiantuntijaryhmien laatimista toimenpide-ehdotuksista. Arvioitujen luontotyyppien kuvaukset, esiintymiskartat, valokuvat sekä luontotyyppikohtaiset arviointitulosten perustelut ovat loppuraportin toisessa osassa, joka on julkaistu vain suomeksi.

Uhanalaisuuden arvioinnissa olivat mukana kaikki Suomen luontaisesti syntyneet luontotyypit sekä perinnebiotoopit. Arvioinnin tulokset esitetään 388 luontotyypille. Luontotyypit on jaettu kahdeksaan pääryhmään: Itämeri (42 luontotyyppiä, joista uhanalaisiksi arvioitiin 24 %), Itämeren rannikko (45 kpl, 58 %), sisävedet ja rannat (59 kpl, 20 %), suot (69 kpl, 57 %), metsät (34 kpl, 76 %), kalliot ja kivikot (44 kpl, 25 %), perinnebiotoopit (42 kpl, 100 %) sekä tunturit (53 kpl, 38 %).

Luontotyyppien uhanalaisuus arvioitiin Suomessa toista kertaa. Arvioinnissa siirryttiin käyttämään kansainvälistä IUCN Red List of Ecosystems -menetelmää. Pääasiallisia arviointikriteerejä olivat luontotyypin määrän muutos, abioottisen ja bioottisen laadun muutos sekä harvinaisuus. Lisäksi arvioitiin luontotyyppien tilan nykyistä kehityssuuntaa.

Koko maassa uhanalaisiksi arvioitiin 186 luontotyyppiä (48 % luontotyyppien lukumäärästä). Etelä-Suomessa uhanalaisten osuus (59 %) on selvästi suurempi kuin Pohjois-Suomessa (32 %). Luontotyyppien ensimmäisen ja toisen uhanalaisuusarvioinnin tulokset eivät ole suoraan vertailtavissa arviointimenetelmän muutoksen vuoksi. Tulosten perusteella voidaan kuitenkin tulkita, ettei luontotyyppien häviämisuhka ole vähentynyt.

Kustantaja	Ympäristöministeriö
Painopaikka ja vuosi	-
Julkaisun jakaja/myynti	Julkaisu on saatavana veloituksetta internetistä: www.syke.fi/julkaisut | helda.helsinki.fi/syke

PRESENTATIONSBLAD

Utgivare	Finlands miljöcentral och Miljöministeriet		December 2019
Författare	Kontula, T. & Raunio, A. (red.)		
Publikationens titel	Hotbedömning av Finlands naturtyper 2018 Rödlistning Resultat och bedömningens grunder		
Publikationsseriens namn och nummer	Miljön i Finland 2/2019		
Diarie-/ projektnummer	-	Tema	Natur
ISBN tryckt	-	ISSN tryckt	-
ISBN PDF	978-952-11-5110-1	ISSN online	1796-1637
URN-adress	http://urn.fi/URN:ISBN:978-952-11-5110-1		
Sidantal	254	Språk	engelska
Nyckelord	Hotade naturtyper, biotoper, Östersjön, kusten, sötvatten, stränder, myrmarker, skogar, hällmarker, vårdbiotoper, fjäll		

Referat

Publikationen sammanfattar den första delen av slutrapporten om bedömningen av hotade naturtyper (rödlistning), som har publicerats på finska. Den innehåller en presentation av bedömningsmetoden, resultat av och grunder för bedömningen samt ett sammandrag av åtgärdsförslag som expertgrupperna utarbetat. Beskrivningar av naturtyperna, utbredningskartor och fotografier samt motiveringar till bedömningens resultat för de enskilda naturtyperna presenteras i slutrapportens andra del, som endast har publicerats på finska.

Bedömningen omfattade Finlands samtliga naturligt uppkomna naturtyper och vårdbiotoper. Resultat presenteras för 388 naturtyper. Naturtyperna har delats in i åtta huvudgrupper: Östersjön (42 naturtyper, varav 24 % hotade), Östersjökusten (45 st., 58 %), sötvatten och stränder (59 st., 20 %), myrmarker (69 st., 57 %), skogar (34 st., 76 %), hällmarker samt sten- och blockfält (44 st., 25 %), vårdbiotoper (42 st., 100 %) och fjäll (53 st., 38 %).

Det här är andra gången det görs en hotbedömning av naturtyperna i Finland. Den här gången tillämpades den internationella metoden IUCN Red List of Ecosystems i bedömningen. Till de huvudsakliga bedömningskriterierna hörde förändring i kvantitet, förändring i abiotisk och biotisk kvalitet samt raritet. Dessutom bedömdes den nuvarande utvecklingstrenden för naturtypernas status.

I hela landet bedömdes 186 naturtyper vara hotade (48 % av det totala antalet naturtyper). I Södra Finland var andelen hotade naturtyper (59 %) betydligt högre än i Norra Finland (32 %). Resultaten från den första och den andra hotbedömningen av naturtyper är inte direkt jämförbara eftersom bedömningsmetoden inte är den samma. På basis av resultaten kan man dock uttyda att hotet om utrotning inte har minskat.

Förläggare	Miljöministeriet
Tryckort och år	-
Distribution/ beställningar	Publikationen är gratis tillgänglig på internet: www.syke.fi/publications | helda.helsinki.fi/syke

The threat status of Finnish habitat types has now been assessed for the second time. The assessment results are provided for 388 habitat types divided into eight main groups: Baltic Sea, Baltic Sea coast, inland waters and shores, mires, forests, rock outcrops and scree, seminatural grasslands and wooded pastures, and fell habitats.

Altogether 186 habitat types (48% of the total number of habitat types) were assessed as being threatened in the whole of Finland. The percentage of threatened habitat types in Southern Finland (59%) is clearly higher than in Northern Finland (32%). The results of the first and second assessment of threatened habitat types are not directly comparable with each other due to changes in assessment methodology. The results do, however, lend themselves to the interpretation that the risk of habitat type loss has not been reduced.

The IUCN Red List of Ecosystems Categories and Criteria was adopted as the method for the second assessment. The primary assessment criteria used were change in habitat type quantity, change in abiotic and biotic quality, and rarity. The current trends for habitat types in terms of their state were also assessed.

The final report in Finnish has two parts. This publication in English is a summary of Part 1 and presents the threat status assessment method, results and basis of assessment as well as a summary of the action proposals drawn up by expert groups. The habitat type descriptions, distribution maps, photographs and habitat type-specific justifications for assessment can be found in Part 2 of the publication only available in Finnish.

SYKE

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

ISBN 978-952-11-5110-1 (PDF)
ISSN 1796-1637 (online)